# MACHINERY.

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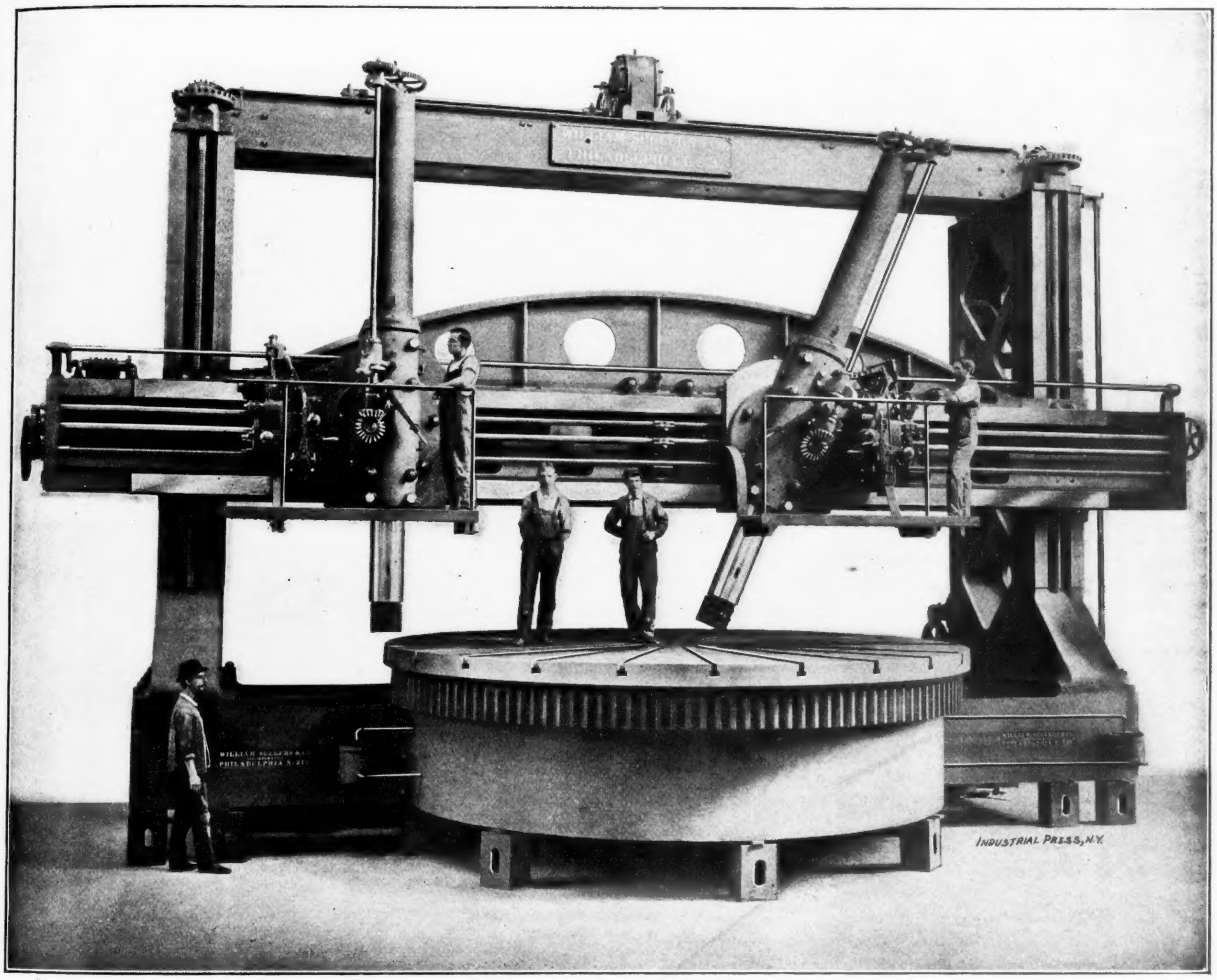
## A NOTABLE BORING AND TURNING MILL.

Something over a year ago William Sellers & Co., Inc., Philadelphia, installed two 28-foot boring and turning mills in Pittsburg, one at the shops of the Westinghouse Electric and Manufacturing Co., and the other at the works of the Westinghouse Machine Co. We have already alluded to these boring and turning mills and have shown illustrations of each of them as they now appear, in connection with articles upon the above plants. Through the courtesy of William Sellers & Co., Inc., we are now able to give further particulars about these remarkable machines and to publish a reproduction from a photograph of one of the mills, taken before it was shipped from the Sellers shops.

is one at the Union Iron Works, San Francisco, Cal. This will admit work 30 feet in diameter without the need of moving the housings, but it is of special design, with somewhat limited capacity, and is less massive and powerful than the Sellers machines.

In any boring and turning mill the crossrail must not only resist the direct thrusts of the cutting tools, but must be able to withstand the torsional stresses when the boring bars are extended for deep boring and turning. It is customary to make a crossrail very deep at the center, but thin at the ends where attached to the housings and it is hollowed out in a trough-like form to afford room for the screws and



Twenty-eight Foot Boring and Turning Mill Built by William Sellers & Co., Inc., Philadelphia.

The capacity of these machines is very great and in points of strength, massiveness and power they probably surpass any boring and turning mills that have ever been constructed. Boring and turning mills for very large work are usually so constructed that the housings may be moved back, away from the center line of the table, to admit the largest diameters of work. Such machines are primarily designed for the smaller work, but upon occasion can be employed for larger work, though at a disadvantage.

In the Sellers mill the housings are not adjustable but the machine as it stands is large enough to admit work 28 feet in diameter. The only mill in the country of larger capacity

feed rods. The resulting section is not well adapted to withstand torsional strains and no amount of "back swell" in the center of the beam will increase the torsional strength at the weakest section, although of importance in resisting the horizontal forces.

In the 28-foot Sellers boring and turning mill the crossrail has been designed with special reference to the torsional strains, which at times must be very great. The housings are of rectangular section, the front and back edges being parallel and the crossrail is extended back to the rear face of the housings where an additional pair of elevating screws and clamping shoes are provided. The crosshead

bar measures 7 feet 6 inches from the front face of the housings to the clamping point on the rear, while the depth is 40 inches. When this great beam, braced by internal diagonal webs, is secured by the front and back to the housings, the device affords a degree of rigidity hitherto not obtained in machines of this character. The front of the crosshead is further stiffened by a curved beam over 43 inches deep in the middle and bolted to the top of the crossrail between suitable cast abutments.

When the crossrail is clamped up for work, it is so thoroughly braced to the two housings that no connection would be needed between them at the upper ends were it not that a support is required to carry the elevating machinery. This support is provided in two 20-inch I-beams, which carry the electric motor used for raising and lowering the crossrail, as well as the necessary shafts, wheels and bearings.

Two saddles are provided, each carrying a 12-inch boring bar of 7 foot stroke. Attached to each of the saddles there is a convenient platform for the operator, and from this position he can control all the movements of the saddle and boring bar. The feed screw for horizontal adjustment is stationary and both saddles have nuts engaging with the screw. Each saddle carries its own feeding mechanism, with change wheels for altering the speeds of feed, and there are within the crossrail two shafts from which power may be taken. The first, which is used for regular feeds, is driven by the driving gear of the boring and turning mill, and runs at a constant speed in relation to the table, while the other shaft is operated by a motor on the back of one of the overhanging ends of the crossrail, which may be stopped and started from either saddle and is used to drive the rapid traverse mechanism. The saddles can be moved along the crossrail or the bar raised or lowered by rapid power traverse, and with great nicety.

The operating levers are so interlocked that the rapid traverse cannot be thrown in for one saddle unless it is disengaged from the other, so that it is impossible for the operator on one head to move the opposite head accidentally. Convenient levers are arranged for throwing in the various movements, so that the operator has perfect control of the movements of the boring bars in every direction.

The vertical feed is accomplished by the heavy screw passing within the boring bar, and is sufficiently powerful to enable the bar to be used for slotting large keyseats where desired.

The great length of the crossrail, nearly 39 feet, makes it necessary to provide intermediate bearings and ingenious drop hangers are provided which will move out of the way as the saddles travel along the rail, but when in action they hold the shafts effectively in closed bearings.

The table is 18 feet 4 inches in diameter and is provided with external spur gearing, protected by an overhanging edge, and is carried on two wide flat annular bearings, and centered by a spindle 25 inches in diameter in a bearing adjustable for wear. The table gear is 4⅝ inch pitch, 11 inch face, and the driving pinion is on the vertical shaft at the rear of the machine.

To insure a thorough lubrication of all the table bearings, a centrifugal force pump is provided which delivers the oil to the vital points, and the overflow is collected, passed through filters and returned to the pump tank by gravity. This system has proved eminently satisfactory in practice, and the lubrication has been all that could be desired.

Two changes of gearing are provided and in the machine shown the drive is directly from an electric motor (20 H. P.) through a Reeves variable speed countershaft.

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The average work of a laboring man is considered to be 2,000,000 foot pounds per day, but this work has been enormously exceeded in individual cases, especially in that of certain long distance bicycle riders. In an article, "The Efficiency of the Bicycle Rider as a Machine," by R. C. Carpenter, published in the *Sibley Journal*, it is shown that the work done in long distance bicycle races has amounted to as much as 15,000,000 foot pounds for one day and 10,000,000 foot pounds average for five days.

## SUCCESS IN HARDENING STEEL.

### PRACTICAL SUGGESTIONS ABOUT THE FIRE, THE STEEL AND THE METHOD OF TREATMENT.

E. R. MARKHAM.

Every shop has one or more men who are considered authorities on this subject. In many cases the man is really an expert, is careful, and uses good judgment in heating the steel and in quenching in the bath; and if the piece is of sufficient size, is sure to take the strains out by reheating directly after taking from the bath. In some cases that have come to the writer's notice, however, the success of an operator was measured by the failure of others, or by the fact that the party was willing to take risks. You cannot scare him with a little thing like a piece of steel. Then if the work passes through the fiery ordeal with enough of it left intact to do the work it is considered a *successful operation;* if not, the fault *must* be in the steel.

I have in mind a manufacturing concern who changed the brand of tool steel they were using three times in less than a year, because the man doing the hardening reported adversely on each make, after attempting to harden it. The article furnished was from three of the leading makers of tool steel. After receiving repeated complaints in regard to the man's inability to harden the steel successfully, one of the makers advised the manufacturers to let some expert in hardening try the steel. Some milling machine cutters were made from each brand of the rejected article, exactly like those they had attempted to harden. Every one came back all right, hard enough, not a tooth missing or a crack anywhere, proving the trouble was not in the steel.

One often hears in machine shops: "If we could only get as good steel as we had twenty-five or more years ago, there would not be so much trouble coming from the blacksmith shop." But the tool steel furnished by the leading makers of to-day is better for the particular purpose for which it is intended than most of the steels of the past. The reason people experience so much trouble in the manipulation of steel are manifold. First, many manufacturers consider only the first cost of the article, not realizing that fifty dollars worth of labor may be put onto twenty-five cents worth of stock, which, when hardened, may be, to say the least, highly unsatisfactory. I do not think it necessary to pay seventy-five cents a pound for steel, when the fifteen-cent article would be all right; neither do I think it good policy to buy a seven-cent steel when a better grade is needed. In other words, it is not advisable to waste dollars trying to save cents, as is the case when steel is bought that is not adapted to the purpose.

An expensive steel is not necessarily a satisfactory investment, and a "cheap" brand may be *very expensive.* It is necessary to understand just what is needed in a steel for a given purpose. Some makers have different grades of steel for different purposes—one for taps and similar tools, another for milling machine cutters, etc.—while others put out a steel that is very satisfactory for most purposes. Each has a good argument in favor of his particular method of manufacture.

In some shops it is thought advisable to use a grade of steel adapted to each individual class of tool; while in other shops, where detail is not followed as closely, this would cause no end of confusion. That part of the subject must be left to the judgment of the individual shop. But the treatment of the steel in the fire and the bath, in order to be successful, must be along certain lines. The successful hardener is he who finds out what particular quality is needed in the piece he is to harden; whether extreme hardness, toughness, elasticity, or a combination of two of these qualities. Then he must know the method to use in order to produce the desired result. The shape of the piece, the nature of the steel, the use to be made of the article, must all be taken into consideration. He must also be governed somewhat by the kind of fire he is to use.

Some brands of steel will not stand, without injury, the range of heat that others will; some require more heat than others in order to harden at all. When hardening, no steel should be heated hotter than is necessary to produce the de-

sired result. With some brands that give off their surface carbon very readily it is not advisable to heat them in an open fire, exposed to the action of the blast and outside air, as the products of combustion extract the carbon to such an extent that the surface will be soft even when the interior is extremely hard. While this might not materially affect a tool that was to be ground, it would spoil a tap, a formed mill, or similar article, whose outside surface could not be removed. In hardening anything of this nature in an open fire, it should be placed in a piece of tube or some receptacle, so the fire cannot come in contact with it while heating. There are a number of gas and gasolene hardening furnaces made which have a muffler to receive the work. The fire circulates around the muffler, but does not come in contact with the steel. Very excellent results may be obtained when one of these furnaces is used. The front can be closed by means of a door usually furnished, thus keeping all outside air away from the work. It will be found a great advantage if several large holes are drilled in the door, these being covered with isinglass, to enable the operator to see the work without removing the door.

Taking carbon from the steel is not the only injury done to a high grade of steel when heated in an ordinary blacksmith's forge by a careless operator. Most inexperienced men are apt to use a small fire, particularly if they find one ready built. It may be mostly burned out, but the operator will not care to take the time to get fresh coal, and get the fire to the proper heat; so he puts on the blast and endeavors to heat the work by means of a dead fire and plenty of *wind.* After a time the piece has all manner of heats, ranging from a low red to a white heat. He thinks it *averages* well, so dips it in the bath. If it comes out in one piece he feels lucky. If it does not have more than two or three cracks, and these where they will do *no harm*, his reputation as a hardener of steel is made.

Heating in a small fire is dangerous business, as the work not only comes in contact with the surrounding air, but with the cold air from the blast, which will cause minute surface cracks, making the steel look as though full of hairs. It will also fill the steel with "strains," causing ends of projections to crack and drop off in the bath.

If obliged to use the blacksmith's forge, have plenty of good charcoal. Make a large, high fire if the piece to be hardened is of any size; keep it up well from the blast inlet, using only blast enough to keep the fire lively, and bring the piece to the proper heat, burying it well in the fire to keep from the air. The lowest heat that will give the desired result should be used. This varies in different makes of steel, and must also be varied somewhat according to size and shape of the work. The teeth of a milling machine cutter will harden at a lower heat than a solid piece of the same size made from the same bar. Most steelmakers in their instructions say to harden at a low cherry red. To the average man this is a very uncertain degree; his cherries may be of a different hue from some other fellow's. My experience has taught me that most of the leading brands of tool steel in small sizes give the best results when hardened just after the black has disappeared from the center of the piece, provided we were heating slowly so as to get a uniform heat. In no case should steel be dipped when there is a trace of black in it.

The higher a piece of steel is heated—to a certain degree—the harder it will be; but if it is heated higher than is necessary the grain is opened, making it coarse and brittle, and it will be very liable to flake off under strain. For this reason, in the case of cutting tools, it is best to harden at as low a heat as possible. If the work gets too hot, yet not to a point where it is burned, it is always best to allow it to cool until the red has entirely disappeared, then to reheat to the proper degree and harden, and the grain will be fine. But if allowed to cool to the proper hardening heat and dipped, it would be as coarse as if hardened at the high heat, and would also be very liable to crack.

In hardening much more depends on the annealing than people in general know of. So much, in fact, that it is as necessary to understand doing it properly as it is to know how to harden aright. As generally understood, the office of annealing is to soften the steel, which is all right, so far as the party is concerned who works it to shape; but its relation to hardening is another matter. It removes all strains in the steel, incident to rolling and hammering in the steel mill and forging in the blacksmith shop. Experience teaches the hardener that it is necessary to anneal any odd-shaped piece or one with a hole or impression in it, after it has been blocked out somewhere near to shape, a hole somewhat smaller than finish size being drilled in it, and all surface scale being removed. The most satisfactory method to pursue is to pack in an iron box with granulated charcoal, not allowing any of the pieces to come within one inch of the box at any point. It should then be placed in the furnace and kept at a bright red heat for a length of time, dependent on the size of the steel. Pieces one inch in diameter should be kept at a red heat for one hour after the box is heated through; larger pieces should be kept hot correspondingly longer, allowing the work to cool off as slowly as possible. An annealing heat should be higher than a heat for hardening the same piece. Experience has taught me that the proper heat for annealing, in order that all strains may be overcome, should be nearly as high as for forging the same piece; in other words, it should be heated to a bright red and kept there long enough to overcome any strain or tension liable to manifest itself when the piece is hardened. Never pack tool steel for annealing in cast-iron chips or dust, as this extracts the carbon to such an extent that there will be trouble when hardening is attempted. Packing too near the walls of the annealing box will have the same effect to a less extent, but will be more troublesome, as the carbon will be extracted from the surfaces nearest the box, and not affected anywhere else, making the hardening very uneven.

If not situated so the above method can be used, very satisfactory results may be obtained by heating in a large charcoal fire to a uniform forging heat. Put two or three inches of ashes in the bottom of an iron box; on this place a piece of soft wood board, put the work on it, cover with another piece of board, and fill the box with ashes. The boards will char and smolder, keeping the work hot for a long time. Some blacksmiths use a box of cold ashes, while others use cold lime; either way is liable to chill the piece, making it harder than if allowed to cool in the air, and if either material is used it should be hot to get good results. Excellent results may be obtained by heating in a muffler oven, as a very uniform heat of any degree may thus be obtained. It can be run any length of time, but when a piece is heated through in this way it takes a long time to cool.

Hardening a piece of steel is generally accomplished by heating to a low red, and plunging in some cooling bath. As so much depends on the bath it is quite necessary to understand the effects of the use of the different kinds. The one most commonly used is clear cold water, though many use salt and water or brine. For hardening small articles that must be extremely hard, the following will be found very satisfactory: One pound citric acid crystals dissolved in one gallon of water. For very thin articles a bath of oil is necessary. For hardening springs, sperm is very satisfactory; when hardening cutting tools, raw linseed oil is excellent. There are hundreds of formulas for hardening compounds, some of which are excellent for certain classes of work. Some hardening solutions are poisonous, and are dangerous to have around; but for ordinary work the ones mentioned are sufficient.

Many successful hardeners use water that has been boiled, claiming better results from its use than from fresh water, which is liable to steam; and this steam, when formed, has a tendency to blow the water from the work, leaving it soft. Small odd-shaped pieces are not so liable to crack nor to harden unevenly when the water is slightly warmed.

We will now consider a few pieces of work to be hardened by the open-fire method. If we have a muffler furnace, so much the better, as with this it is easier to get certain results; but with care very satisfactory work can be done when the blacksmith forge is used. If it is a small tap, reamer, counterbore, or similar article we are to harden, it

is best to heat in a tube, bring to a low red, plunge in slightly warm water, or in the citric acid solution. If it is a hollow mill, with a hole running part way through it, we should dip it in the bath with the hole up, or the steam will keep the water from entering the hole, leaving the inside walls soft. The steam would also have a tendency to crack the piece; but with the hole up when dipping, by working the piece up and down well in the bath, the steam can escape, and the water can get at the work. Much bother may be saved the hardener if attention is paid to the steam likely to be generated, providing some way to prevent its keeping the water from the work. Brine does not steam as readily as clear water; neither do the different acid solutions used by many.

In hardening a milling machine cutter it is best to have a large, high fire, to bury the cutter well in the fire, and to use only blast enough to bring the work to the required heat, which should be uniform throughout. If the piece has not been annealed after drilling a hole through it, remove it from the fire when red hot, then allow it to cool off slowly until the red has entirely disappeared, when it can be again placed in the fire, slowly brought to the required heat, plunged in the bath of tepid water or brine and worked around well until it stops "singing." At this point it should be removed and instantly plunged in the oil bath, and left there until it is cool, when the strain should be removed by holding over the fire until it is warm enough to snap when touched with the moistened finger. It can then be laid aside, and the temper drawn at leisure. In hardening punch press dies we can treat them the same; if there are any screw holes for stripper or guide screws they should be plugged with fire clay or graphite. Much depends on an even uniform heat; uneven heats cause more tools to crack than high heats, although steel should not be given any more heat than is necessary.

Metal slitting saws can be hardened nicely between iron plates whose surfaces are kept oiled. The saws should be heated in such a manner that the fire does not come in contact with them. It is best to heat on a flat plate, as the tendency to warp is much less than if laid on an uneven surface. When the saw is properly heated, place on the lower oiled plate, placing the other one on it as quickly as possible; hold down hard until the saw is cool. If there are many such pieces to do, a fixture can be made so that one man can handle the saws and fixture alone; otherwise it takes two.

If there is no other means of drawing temper, brighten and draw by color; but, if possible, do it in a kettle or crucible of oil over the fire, gaging the heat by a thermometer. Much more satisfactory results can be obtained by this latter method; and if very many pieces are to be done, it will be found much cheaper. A very light yellow is 430 degrees; a straw color is 460 degrees; a brown yellow, 500 degrees; a light purple, 530 degrees. A milling machine cutter for ordinary work should be drawn to 430 degrees; a punch press die to 500 degrees; the punch to 530 degrees, and metal slitting saws to 530 degrees.

So much depends on the judgment and carefulness of the operator that men in charge of manufacturing plants should use great care in selecting a hardener, on whom depends the condition of the tools. The cost account may be increased or reduced materially by him. One cutter hardened and tempered properly will do many times the amount of work of one improperly done, to say nothing of the expense saved in grinding and setting machine, etc. As to the grade of steel to use, most of the leading brands of tool steel will give good results if properly handled.

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While gasoline engines are common enough, gasoline locomotives are somewhat of a novelty. They are made, however, and are used mostly for mining purposes. The Prouty gasoline locomotive, recently illustrated in the *Mining and Scientific Press*, San Francisco, is built in sizes to haul from 15 to 100 tons, some sizes being designed to run on tracks as narrow as 18-inch gage. They have the advantage of steam locomotives for tramways in that there is no smoke and they are more easily managed. As in gasoline automobiles, the engine runs continuously in one direction and the speed variation and reversal are obtained through intermediate mechanism.

## GEARING.—1.

### CALCULATIONS CONNECTED WITH THE DESIGN OF GEAR WHEELS—VELOCITY RATIO—SIZING THE BLANKS.

C. F. Blake.

Several years ago, through no fault of my own, I was young, so young indeed that upon giving the blueprint boy a vacation the chief draftsman put me in his place, and handing me a copy of Brown & Sharpe on gearing, said, "You can pass your spare time profitably in studying this." Since that time I have noticed there exists some inseparable tie between the drafting room apprentice and gearing. As soon as the boy has learned to draw circles with a compass and straight lines with a ruling pen he looks round for something to draw, and

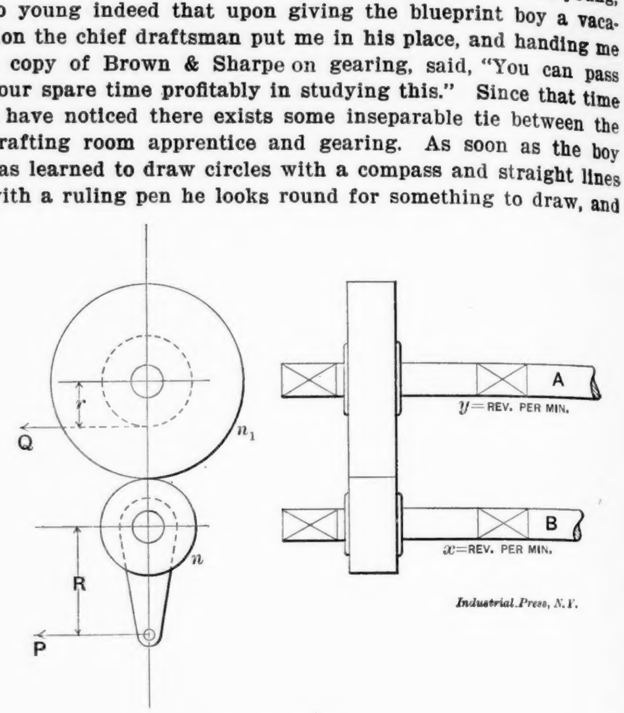



Fig. 1.

usually hitting upon a gear asks to be shown how to draw the teeth. As Grant says in his treatise upon this subject, a gear "is one of the most interesting objects in the field of scientific research, and not the simplest one;" although the actual calculations required for the design of a pair of gears according to the usual shop practice are few and simple. It is to put these calculations into easily-understood form that the present article is undertaken, there being little new or original to be said, although some of the tables it is believed have not before been published.

Table I.

| Number of Teeth. | Constant K. | Number of Teeth. | Constant K. | Number of Teeth. | Constant K. |
|---|---|---|---|---|---|
| 12 | .258 | 31 | .102 | 52 | .059 |
| 13 | .239 | 32 | .097 | 54 | .057 |
| 14 | .222 | 33 | .094 | 56 | .055 |
| 15 | .207 | 34 | .093 | 58 | .053 |
| 16 | .195 | 35 | .089 | 60 | .052 |
| 17 | .184 | 36 | .087 | 62 | .049 |
| 18 | .173 | 37 | .084 | 64 | .048 |
| 19 | .165 | 38 | .082 | 66 | .045 |
| 20 | .156 | 39 | .080 | 68 | .044 |
| 21 | .148 | 40 | .078 | 70 | .043 |
| 22 | .141 | 41 | .076 | 75 | .041 |
| 23 | .136 | 42 | .075 | 80 | .039 |
| 24 | .130 | 43 | .073 | 85 | .036 |
| 25 | .125 | 44 | .071 | 90 | .034 |
| 26 | .120 | 45 | .069 | 95 | .032 |
| 27 | .115 | 46 | .067 | 100 | .031 |
| 28 | .112 | 47 | .066 | 125 | .025 |
| 29 | .107 | 48 | .065 | 150 | .019 |
| 30 | .104 | 49 | .063 | 175 | .017 |
| | | 50 | .061 | 200 | .015 |

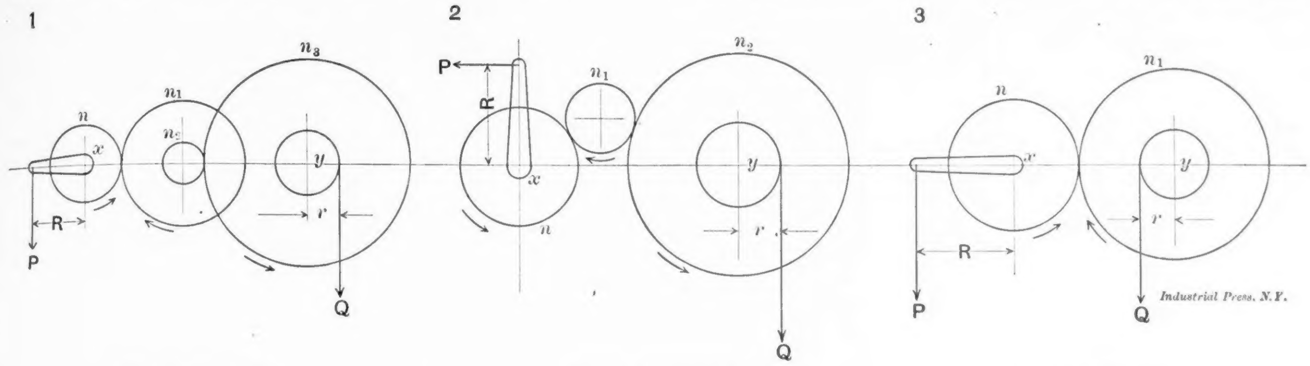
The calculations should be made in the following manner: First—Find out if the gears are intended to give a certain *velocity ratio* between two shafts, or a certain *power ratio* between the shafts; and, assuming the number of teeth in one gear, make the number of teeth in the other gear such as to have the *required ratio* to the number of teeth in the first gear. Second—Assume the pitch of the gears and calculate the pitch diameters of the two gears, and the distance

This article is to be published in two installments and places in convenient form for reference the information upon gear wheels most often needed by draftsmen.—Editor.

between the centers of the shafts. Third—Calculate the width of face required to give the gears proper strength. Fourth—Lay out the gears and the tooth forms. The relations of these several steps one to another are such as to make some assumptions necessary and these depend upon the judgment and experience of the designer, especially when the distance between the shafts is approximately settled and certain ratios are to be obtained without materially changing the shaft centers. In the case of the younger designers, however, these assumptions are all made beforehand and given to them with instructions to lay out the gears. The several steps will now be taken up and each explained.

the weight arm times the product of the number of teeth in the driving gears equals the weight.

Fig. 2 shows in tabular form several different forms of gear trains with their formulæ for speed and power ratios. It is to be noted that in place of using the numbers of teeth in these ratios we may use the pitch diameters of the gears, but as these diameters are very often expressed in fractional parts of an inch, while the number of teeth is always a whole number, it is found more convenient to use the latter. Idlers are often used, as shown in the sketch in section 2, Fig. 2, and as they have no effect upon either the speed or power ratios they are introduced either to connect two shafts where the




**First Illustration.**

Speed ratio:

$$\frac{x\, n\, n_2}{n_1\, n_3} = y$$

Power ratio:

$$\frac{P\, R\, n_1\, n_3}{n\, n_2\, r} = Q$$

**Second Illustration.**

Speed ratio:

$$\frac{x\, n\, n_1}{n_1\, n_2} = \frac{x\, n}{n_2} = y$$

Power ratio:

$$\frac{P\, R\, n_1\, n_2}{n\, n_1\, r} = \frac{P\, R\, n_2}{n\, r} = Q$$

Note.—As the number of idlers cancels out they do not affect the result.

**Third Illustration.**

Speed ratio:

$$\frac{x\, n}{n_1} = y$$

Power ratio:

$$\frac{P\, R\, n_1}{n\, r} = Q$$

NOTATION.—$n\ n_1\ n_2\ n_3$ = number of teeth in gears. $x$ = rev. per min. of power shaft. $y$ = rev. per min. of driven shaft. $R$ – rad. of power arm. $r$ = rad. of load arm.

Fig. 2. Diagrams Illustrating Speed and Power Ratios of Gearing.

### To Calculate the Ratios Required of a Pair of Gears–Speed Ratios.

Fig. 1 represents two shafts connected by a pair of spur gears, $A$ being the driven shaft and $B$ the driving shaft. If shaft $A$ is required to revolve half as fast as shaft $B$, it is easily seen that the gear on $A$ must be twice as large, and being of the same pitch must have twice as many teeth as the gear on $B$. If $n$ and $n_1$ represent the number of teeth in each gear respectively we have the proportion,

$$y : x :: n : n_1 \quad \text{or} \quad \frac{x\, n}{n_1} = y$$

If now a third shaft were to be driven by gears from shaft $A$, we could assume $A$ to be the driver revolving $y$ times a minute, and by the above proportion determine the revolutions of the third shaft, and so continue indefinitely for as many shafts as are geared together in any one train.

Thus follows the rule:

**The speed of the last shaft equals the speed of the first shaft multiplied by the product of the number of teeth in the driving gears and divided by the product of the number of teeth of the driven gears.**

### Power Ratios.

In case a certain ratio of power is wanted, we shall find some sort of a crank or pulley, the radius $R$ of which is known, upon the power shaft $B$, and upon the driven shaft there will also be some sort of a crank, pulley or drum, the radius $r$ of which is known. We can now make the equation (referring to Fig. 1).

$$\frac{P\, R\, n_1}{n\, r} = Q$$

This expression may be made general by following through as before from shaft to shaft, and may be given as the following rule:

**The power, multiplied by the power arm, times the product of the number of teeth in the driven gears, and divided by**

great distance between centers would involve very large gears if geared directly together, or to effect a change in direction of motion, as may be seen by the arrows in Fig. 3. An inspection of this sketch will prove the rule that an even number of idlers does not change the direction of motion between two shafts, while an odd number of idlers reverses the direction of motion.

Having determined upon the velocity or power ratio required of our gears the next step is to determine the two pitch diameters of the gears. To do this it is necessary to assume the pitch of the gears, and this assumption depends

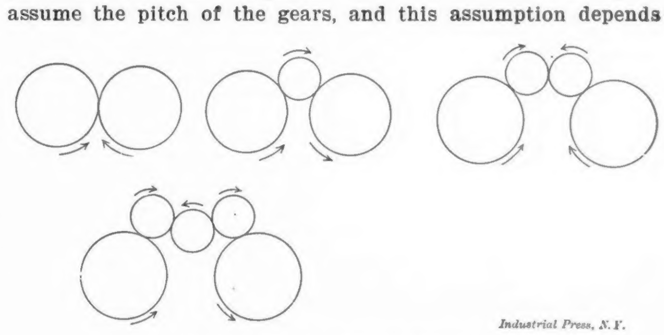



Fig. 3. Showing Effect of Idlers.

upon the judgment and experience of the designer, although very often it may be confirmed by comparison with gears of about the same size and doing about the same work as those to be designed. After assuming the pitch and finding the pitch diameters, a calculation for the strength of the gears will show whether the assumed pitch is right, and if it then proves to be too small or too large this step may be repeated with another assumed pitch.

It is first necessary to understand what is meant by the pitch of a gear, and its relation to the diameter. Fig. 4 shows a gear of twelve teeth (such a small gear is often called a pinion) and the names of the different parts are clearly indicated. As will be seen the circular pitch is the distance on

the pitch circle from a point on one tooth to the corresponding point on the next tooth. The circumference of the pitch circle is equal to the pitch multiplied by the number of teeth and dividing this by 3.1416 gives the diameter of the pitch circle, or

$$d = \frac{p\,n}{3.1416}$$

when, $d$ = the diameter of the pitch circle,
$n$ = the number of teeth,
$p$ = the circular pitch.

After having determined the pitch diameter and drawn the pitch circle we must divide the pitch circle into as many equal parts as the number of teeth, or, what is the same thing, lay off the circular pitch upon the pitch circle. In the case of a small pinion, such as Fig. 4, this may be most easily done by trial with a pair of dividers. It very often happens, however, that the gear is so large as to make this method impracticable because only a portion of the gear showing a few teeth will be drawn. It thus becomes necessary to have some method of accurately laying off the circular pitch upon the pitch circle when only a portion of the circle is drawn. From Fig. 4 it is evident that if we set our dividers to the circular pitch and attempt to step off the spaces, what we shall actually be stepping off will be chords instead of circular arcs, and the resulting arcs will be greater than the circular pitch. In very large gears this error is very small, but in ordinary gears it is quite appreciable, and the dividers should be set to the chord pitch. Table I. has been computed to enable the chord pitch to be easily determined, as the pitch diameter multiplied by the constant $k$ opposite the number of teeth in the gear equals the chord pitch.

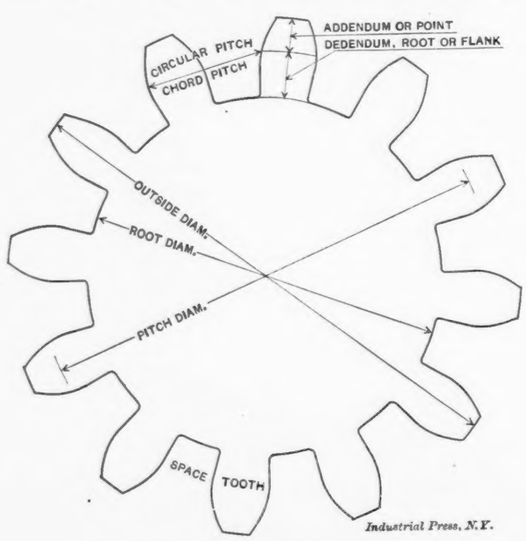



Fig. 4. Chord Pitch and Circular Pitch.

Molded or rough-cast gears are usually designed by circular pitch, but cut gears are designed by what is known as diametral pitch. Since the number of teeth bears a fixed relation to the pitch circumference, and the pitch diameter bears a fixed relation to the pitch circumference, it follows that the number of teeth bears a fixed relation to the pitch diameter. This being so we may divide the pitch diameter expressed in inches by the number of teeth, and the result will be what is termed the diametral pitch. It is also evident that if the number of teeth bears a fixed relation to the pitch circumference and pitch diameter, the circular pitch and diametral pitch must have some fixed relation to each other. These different relations are most conveniently given for use as follows:

| Circular pitch $= p$. | Diametral pitch $= P$. |
|---|---|
| $d = \frac{p\,n}{\pi}$ | $d = \frac{n}{P}$ |
| $p = \frac{d\,\pi}{n}$ | $P = \frac{n}{d}$ |
| $n = \frac{d\,\pi}{p}$ | $n = P\,d$ |
| $D = d + 0.6\,p$ | $D = \frac{n+2}{P}$ |
| $c = \frac{d+d_1}{2} = \frac{p\,n}{2\,\pi}$ | $c = \frac{d+d_1}{2} = \frac{N}{2\,P}$ |

Relation of circular and diametral pitch.

$$p\,P = \pi \qquad p = \frac{\pi}{P} \qquad P = \frac{\pi}{p}$$

$\pi$ = 3.1416,
$p$ = circular pitch,
$P$ = diametral pitch,
$d$ = pitch diameter,
$d_1$ = pitch diameter of mating gear,
$D$ = outside diameter,
$n$ = number of teeth,
$N$ = number of teeth in a pair of gears = sum of the teeth in each gear,
$C$ = the distance between centers of shafts.

When designing cut gears it is not necessary to lay out the form of the teeth, as these are formed by the gear-cutting machine, and it is only necessary for the designer to calculate the pitch diameters that will give the required ratios and then to find the outside diameter of the blank from which the gear is to be cut. For such gears diametral pitch is a great convenience, as the relations of pitch, diameter and number of teeth are so simple.

* * *

## MECHANICAL NOVELTIES.

F. W. Harris, Pittsburg, Pa., sends a description of what is known among shop men as a "pick up" trolley. In other words, it is an electric trolley wheel that never slips off. It is, however, suitable only for straight runs.

Fig. 1 shows the trolley wheel and its attachment to the moving crane. Fig. 2 shows the support for the trolley wire.

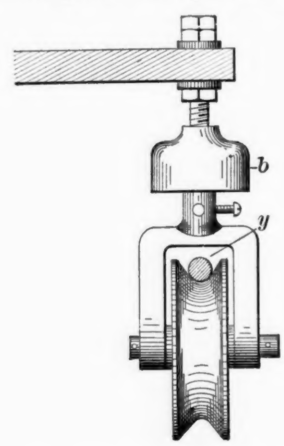



Fig. 1.

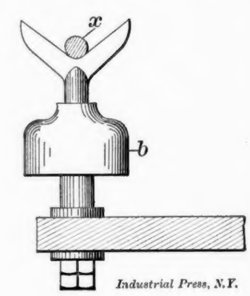
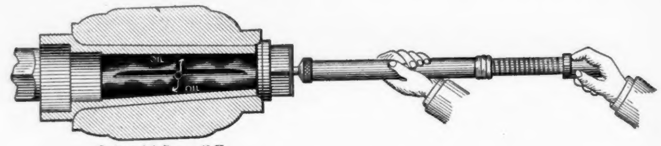



Fig. 2.

Normally the trolley wire rests in the support as at $x$, Fig. 2, but as the crane comes along the wire is lifted by the wheel, to the position $y$, Fig. 1. As the crane passes the wire again falls into its supports. The knobs $b$ $b$ are of mica, thus insulating the supports and trolley fork from the members to which they are attached.

### METHOD OF LUBRICATING WAGON AXLES.

The time-honored way of oiling wagon axles is to remove the axle nut and the wheel, and thus expose the axle to be oiled. On heavy vehicles this necessitates the use of wagon jacks, so lubricating must be done where a wagon jack is available. Hundreds of wagon jacks have been patented, and thousands of them sold. A new scheme knocks the wagon




jack into a "cocked hat," so far as oiling is concerned, as it makes it unnecessary and requires only a fraction of the time. No tools are required except the "squirt-gun" for the oil. The spindles are made with a ¼-inch hole through the center to where the radial holes are drilled to distribute the oil. The opening in the end of the axle is covered by a spring cap. The sketch tells the rest of the story.

# ELECTRICALLY DRIVEN MACHINE TOOLS.—2.

## THE APPLICATION OF MOTORS TO BORING MILLS.

A. L. De Leeuw.

A great deal of what has been said about lathes is also applicable to boring mills; for a boring mill is essentially a lathe, set on end. The main differences in the two classes of machines are more structural than functional. There are, however, certain points in which the boring mill differs from the lathe, making it necessary to treat this machine by itself.

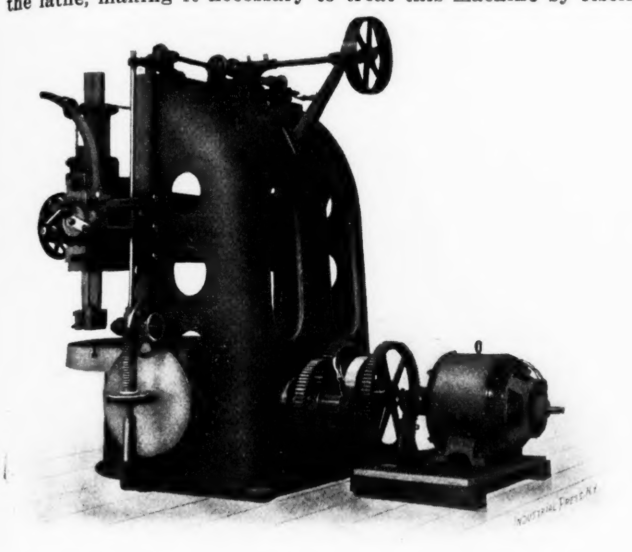


Fig. 1. Fifty-one Inch Boring Mill with Direct Electric Drive.

In the first place, while a lathe of moderate size is driven either directly by the belt or else by back gears, the boring mill is always driven by a belt in connection with some gearing; that is, there is always some of the gearing left in the boring mill, though the back gears may be disconnected. This, of course, makes the drive more powerful; but, at the same time, does not allow such high table speeds. The higher speeds on the lathe are used for filing and polishing, and these operations are out of place on a boring mill. It follows that the range of speeds needed for a boring mill is governed by the range of diameters to be turned or bored, and to the different cutting speeds, necessary for different materials. Take, for instance, a 72-inch boring mill; the largest diameter to be turned up is, of course, 72 inches, and the smallest diameter to be bored is not likely to be less than 3 inches. This gives a range of table speeds of 24 to 1. Add to this the extreme variations in hardness of work, which may sometimes call for a cutting speed of 15 feet, and then again of 25 feet, and the total range of speed becomes $24 \times \frac{25}{15} = 40$. This is really more than is necessary, for it is not likely that so small a hole as a 3-inch one should be bored with a cutting speed of 25 feet per minute. As contrast, take the 72-inch lathe, with worm drive, illustrated in the previous article. Besides requiring the same range of speeds as the 6-foot boring mill, it also required a filing and polishing speed, for which purpose the faceplate ran 60 R. P. M. In order to have a cutting speed of 15 feet per minute, on a diameter of 72 inches, the faceplate had to run .8 R. P. M. This gives a range of speeds of 75 to 1; and it is not difficult to see that such an extremely wide range of speeds places serious difficulties in the way of the designer, if he wants to avoid high speeds of the various shafts. In the above-mentioned 72-inch lathe, a worm and worm wheel were parts of the driving gear, which was done so as to get great power with few running gears, and consequently, noiseless action. An elaborate system of clutches, levers, etc., had to be placed in the headstock, to enable the operator to quickly change from low to high speeds, and *vice versa*, and to disengage all gears except those actually at work, when running at high speed. Such elaborate mechanisms can generally be avoided in boring mills, for the reasons stated above.

Fig. 1 shows a 51-inch Niles mill, with direct electric drive. In this case the motor was worked on the multiple voltage plan, and its range of speeds was fully as large as the range obtained by the ordinary driving cone. All that was necessary, therefore, was to substitute a sleeve for the driving cone, key a gear to this sleeve, and drive this gear by means of a pinion on the motor shaft. As in the ordinary construction, the cone can be locked to the main driving gear, by means of the stop block; and as the cone was missing here, it became necessary to also key a carrier plate to the sleeve, which carrier plate was provided with notches intended for the same function as the notches in the ordinary cone. The elevating of the cross rail is generally accomplished by a belt, running from a pulley on the countershaft to a pulley on the top brace of the machine. In this case, the same result was obtained by placing a pulley on the aforementioned sleeve, and belting up to the top brace. This pulley, of course, has as many different speeds as the motor; but it is so easy to control the motor speed by simply turning a handle, that the operator is always able to get the speed best adapted for elevating. The drive shown here is of extreme simplicity, and is, I am sorry to say, rather exceptional.

Fig. 2 shows a partly completed 10-foot boring mill. This mill was also driven by a variable speed motor, but the range of speeds of the motor was not quite so large as the range of speeds obtained by shifting the belt on the driving cone of such machines. For this reason, two gears were keyed to the sleeve, which takes the place of the cone. These gears were made to slide in the sleeve, and could be brought in mesh with two pinions keyed to an extension of the motor shaft. This extension was coupled to the motor shaft proper, and the coupling was so arranged as to serve at the same time as elevating pulley. Instead of using two sliding gears, two sets of back gears might have been used. The reasons why sometimes one, and sometimes the other is done, are considerations which lie entirely outside the machine. For instance, it may be that the boring mill is sold when it is partly finished, and that the purchaser requires that the machine be electrically driven, in which case it is too late to put a second set of back gears on the machine.

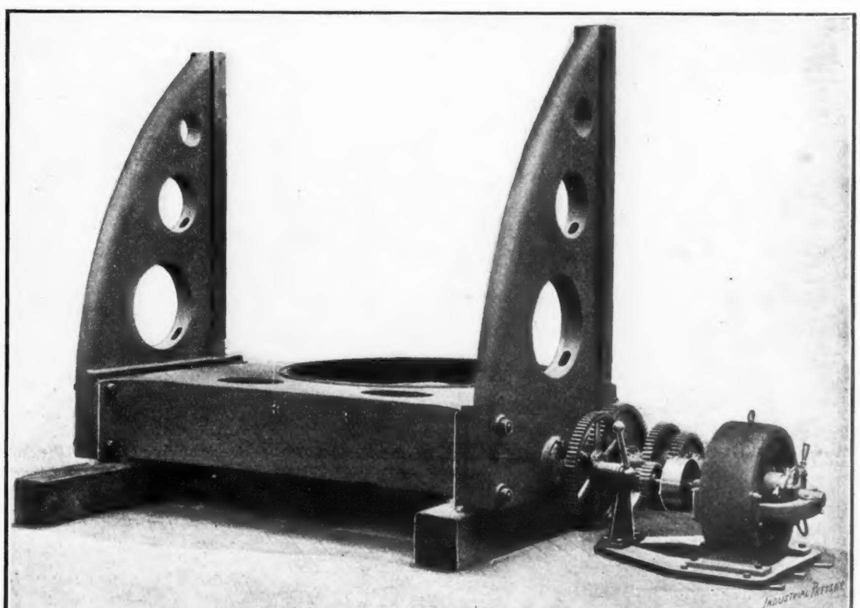


Fig. 2. Ten-foot Boring Mill, partly completed, Driven by Variable Speed Motor.

It may not be amiss to show by an example how this second set of back gears is figured. Suppose the total range

you want to obtain is 48 to 1; and suppose further, that the motor has a range only of 3 to 1; then the question arises, What back-gear ratios shall be used? In order to make all the speeds useful, it is necessary to have them climb up with practically even gradations. It is not absolutely necessary

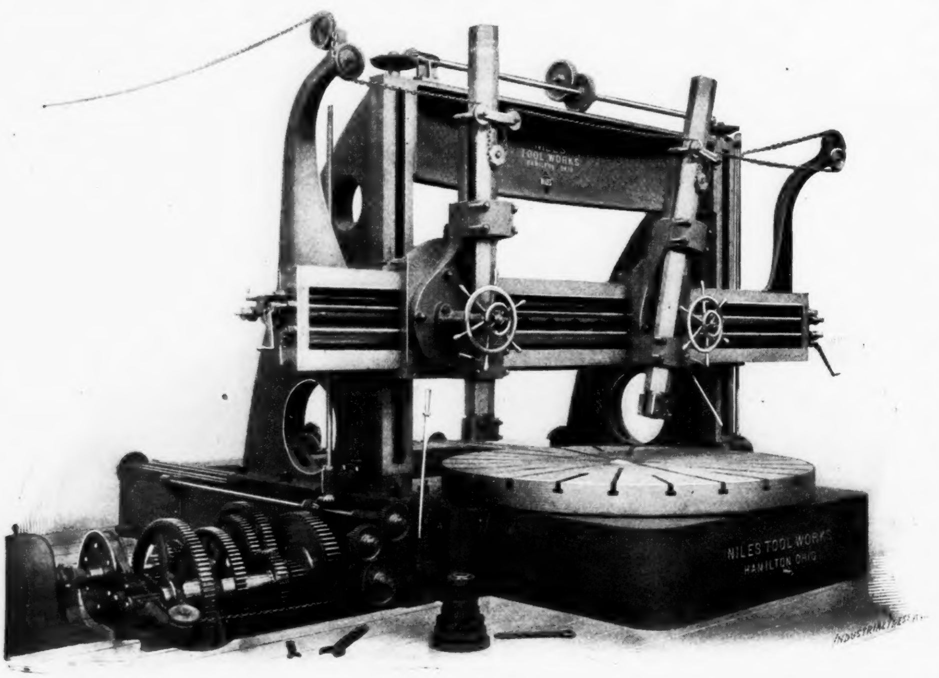


Fig. 3. Ten-by-sixteen Foot Boring Mill, Driven by Motor, with Speed Variation of only Two to One.

that all the speeds should be in *geometrical progression*, notwithstanding that this geometrical progression is advertised as one of the most beautiful features of every lathe ever built. I know I will be considered a heretic for saying this; but I really and honestly cannot see the good the geometrical progression does. If I had a 6-foot boring mill, with a total speed range of 40 to 1, and with only six speeds, I am sure I would not want these speeds in geometrical progression. To more clearly show my reasons, we will assume that the lowest speed of this boring mill is one revolution in 72 seconds; which gives a cutting speed of nearly 16 feet per minute. The next speed of the geometrical progression is about 2.1 times faster, and therefore corresponds to the proper speed for a diameter of 34 inches. Now suppose I had to turn up a steel plate, or rather ring, 72 inches outside diameter and, say, 36 inches inside diameter. I dare not cut at a higher speed than 16 feet per minute. If I use a 1-32-inch feed, it will take me 11½ hours to take one cut over this plate, because I cannot use any but the lowest speed of the boring mill. Now, what I would do in arranging the speeds of the boring mill would be this: I would bunch several of the lower speeds together, so as to get the benefit of the variable speeds on the larger diameters. Of course I would not get quite as many variations of speed on the smaller diameters as one might have, but then a job on a small diameter never consumes much time; and therefore it does not cause such a waste of time if one has to use a speed which is not quite high enough. It seems to me that some common sense in the arrangement of the speeds of a machine is at least as good as a geometrical progression.

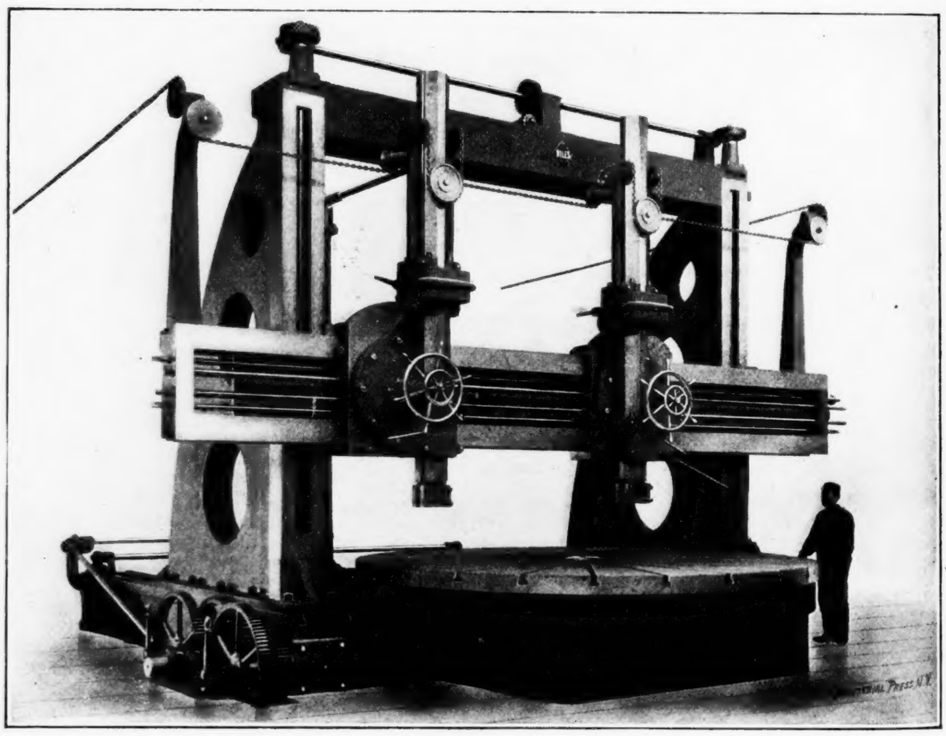


Fig. 4. Extension Boring Mill, 16 by 24 Feet, Driven by a 15 H. P. Two-phase Motor.

To come back to our second back-gear ratio: Starting with the highest speed, that is without any back gears in at all, we may call that speed 48; and we will have to come down gradually to a speed which we will call 1. In the first place, we go down by slowing the motor down. When the motor has reached its lowest speed, the speed of the boring mill will be 48/3=16. If we use the low speed of the motor, and throw the slow back gear in, the speed of the boring mill must be 1; therefore, using the same gearing, with the high speed of the motor, the speed of the boring mill will be 3; and we must now find a second set of back gearing, which will give speeds between 16 and 3. This back gear ratio might be any number, which, divided into 48, will give a speed lower than 16. It might be 3 1-3, 3½, etc.; and by a couple of trials, we find that a second back gear ratio of 4 to 1 makes pretty nearly an equal gradation of speeds. The result will be as follows:

No back gear........speeds 48 to 16.
Fast back gear........speeds 12 to 4.
Slow back gear.......3 to 1.

The use of two pinions on the motor shaft, and two sliding gears on the driving gear sleeve, will give a similar result, though somewhat different numerically. Suppose the back gear were out, and the largest of the two motor pinions engaged; then we would get the highest speed of the driving shaft. Let us call this speed again 48. Going down the range of motor speeds, we shall come to a speed which we will call 16. Now, using the small motor pinion and the highest motor speed, and still without back gear, we would come to a speed which we will call 12. In order to do so, the motor pinions and their sliding gears must be so proportioned that the one will give a speed four times greater than the other. Going down the motor speeds again, we now come to a speed which

will be 12/3=4. Using a back gear ratio of 16, and going through all the different combinations again, but with the back gear now in, our speeds will be 3, 1, ¾ and ¼; so that our total range of speeds is from 48 to ¼, or four times greater than with the double back gears. If we were satisfied with a speed range of 48 to 1, then this arrangement would have allowed us to use a motor with less speed variation, and with smaller gaps between the speeds. One of the drawbacks of this arrangement, however, is, that it is not so easily handled as the double back gear arrangement, and that it requires much more floor space.

Fig. 3 shows a 10 by 16-foot boring mill, driven by a motor, which has a speed variation of only 2 to 1. To get the necessary range of speeds in the boring mill, the arrangement of two pinions and sliding gears was used, and besides there were two back gear ratios, by using what in a belt-driven machine would be called two cone pinions, and two gears sliding on the back gear quill. This mill was provided with three motors, two of which are not shown in the illustration. One was used for the drive, one for the elevating of the cross rail, and one for moving the housings, and it need hardly be said that the last two motors were reversible. For large mills this arrangement is much to be preferred over the arrangement with only one motor, and is, in most cases, cheaper.

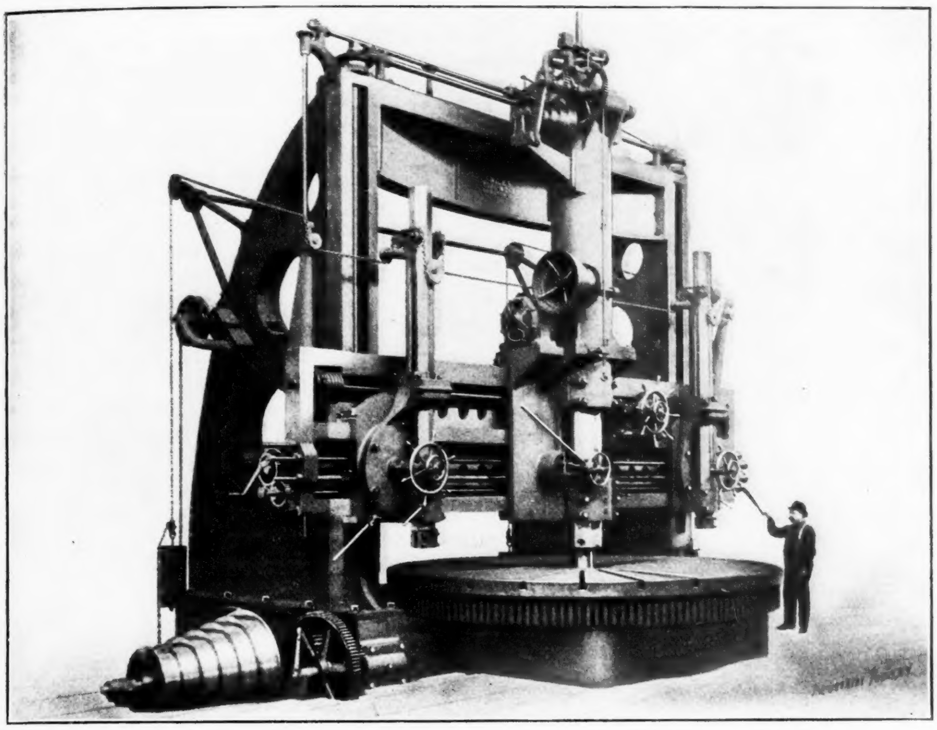


Fig. 5. Boring Mill with three Motors, showing what can be done where there there is no Line Shafting.

Though this is not part of the description of the electric drive, it may interest the reader to know that this mill was intended mainly for the turning and grooving of large hoisting drums. The grooving of a hoisting drum is really a job of screw cutting on a large scale, and for this reason a positive ratio is required between the motion of the boring bar and the motion of the table. The reader will recognize, near the left-hand housing, some change gears, a horizontal splined shaft, a pair of bevel gears, a vertical splined shaft, and some feed mechanism behind the cross rail, all of which was used to impart the proper motion to the left-hand boring bar. Besides this, a lever may be noticed, which operates a brake acting on a brake wheel on an extension of the motor shaft. This is to enable the operator to stop the table in any position required. After turning off the current, the operator waits until the table (now driven by the momentum of the armature and other rotating parts) comes around to where he wants it, when he quickly applies the brake, and this brings the table to a sudden stop.

Fig. 4 shows a 16-foot by 24-foot extension boring mill, driven by one 15 H. P. two-phase motor. The problem of the speed variations is solved here by employing a Reeves variable speed countershaft, which cannot be seen in the illustration, as it is built under the floor. The motor is geared to a shaft upon which two friction clutches are seated. One of these is geared to the first shaft of the Reeves transmission, and drives the boring mill table; the other is geared to a slanting shaft, visible at the left, which in its turn drives a shaft at the rear end of the mill. From this shaft the motion is taken for moving the housings, and for elevating the cross rail. A comparison of the mill and the man in the illustration shows that the mill is not a small affair. The span between the housings is 16 feet; the diameter of the table is 14 feet; the main gear has 164 teeth, one diametral pitch, and 10 inches face. The bars have 72 inches vertical movement. The mill admits eight feet under the tools.

Fig. 5 shows a 16-foot boring mill of a very special construction. It is not so much an example of an electric drive applied to a boring mill, as an example of what can be done when motors are used instead of line shafting. The mill is driven by a cone and belting. A floor countershaft is used, which is driven by a motor. All the motors used on this machine are of the two-phase type, and are consequently, of the constant speed variety. A second motor, hidden in the illustration by other parts of the machine, is placed on the top brace, and serves for elevating the cross rail and for the power quick traverse of the saddles along the cross rail, and of the boring bars. This quick traverse movement is taken by slip gears on the left-hand side of the cross rail.

A third motor is used to give motion to a 9-inch boring bar in the large central saddle, which may be seen projecting into the table. The large central saddle carries two boring bars, an 18-inch cast steel bar, with a movement of 7½ feet up and down, and a 9-inch forged steel bar, telescoping into the first. The 18-inch bar has the same movements as the regular boring bars of an ordinary mill, that is, it can feed with its saddle along the cross rail, and has a power as well as a hand feed up and down. The saddle and the bar have also a quick movement by power. The 9-inch inner bar is a revolving spindle, driven by the third motor. The main elements of this drive may be easily distinguished in the illustration. One can see the motor which drives the lower cone, the upper cone, two sets of gears and a clutch (to extend the range of speeds), and a worm and wormwheel. The feed for this 9-inch bar is taken from the worm shaft. A shaft is carried down to the saddle, where it gives motion to a nest of gears which serve for feed or quick traverse, according to which way a clutch is thrown in, after which the movement is carried up again, by means of a second vertical shaft, and finally revolves a feed nut. A portion of the screw, operating in this nut, may be seen at the extreme upper part of the illustration. The inner bar has a feed movement of 10 feet. The width between housings is 16 feet; diameter of table, 14 feet; face of cross rail, 60 inches; weight of cross rail and parts, 85,000 pounds; extreme height, from bottom of spindle step to top of feed screw for inner boring bar, 48 feet.

* * *

Repeated stresses in bolts in machinery subjected to shock and jar frequently cause them to fracture across the threads. This is due to slight elongations of the bolt at its weakest part, which is its threaded portion. The effect may be counteracted by reducing the sectional area of the body of the bolt so its diameter will be smaller than at the roots of the threads.

# TURRET LATHE FIXTURE.

### A HANDY ATTACHMENT FOR FORMING IRREGULAR PIECES.

JOSEPH V. WOODWORTH.

The turret lathe fixture shown in the accompanying engravings is for forming pieces of irregular outline from the

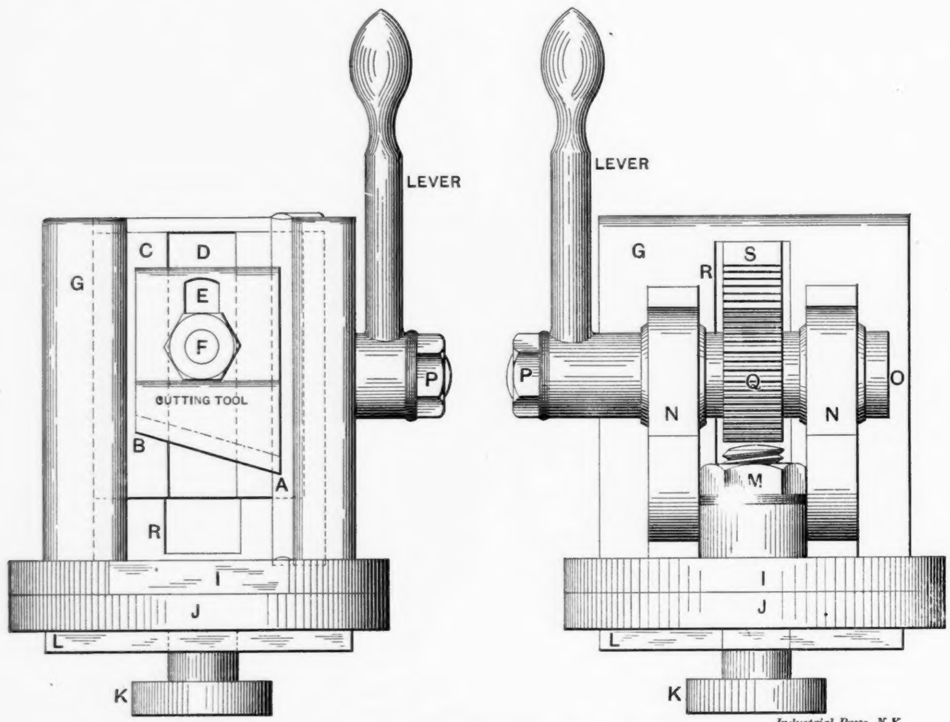



Fig. 1. Front and Back Views of Special Turret Lathe Fixture.

bar. It is adapted for work having considerable stock to be removed and will duplicate the pieces very accurately and leave the finished surfaces smooth and free from tool marks. As it is always ready for use and can be fastened in place on the turret lathe and set for the results desired in short order, it should find a place in all shops where the value of the turret lathe is appreciated.

In Fig. 1 are front and back views of the fixture complete, while Fig. 2 is a side view, as the fixture appears when bolted to the back of a turret lathe cross slide. The latter view also shows the manner in which the cutting tool is presented to the work.

The fixture proper consists of two main parts of cast iron—the round base *J* and the body casting *I*, constructed to swivel on it. The front *G* of the body casting is dovetailed and has a gib *H* for the steel slide *C*. The ribs *N N* act as strengthening ribs for the front and also as bearings for the pinion and lever stud *O*. The steel slide rack *S* is fastened within a shallow channel in the back of slide *C* and an oblong opening *R* allows the rack to project through the front *G* and mesh with pinion *Q*. This allows slide *C* to be moved up or down by the lever at the side. The pinion stud *O* is of tool steel and has a large head at one end and is reduced and threaded on the other for the lever and fastening nut *P*. The lever and pinion are keyed to the stud.

The front or face of the steel slide *C* is finished on an incline at approximately the angle that would be adopted for the front clearance of a lathe tool. This is done so as to avoid having to give this clearance to the cutting tool, which is fastened to the face of the slide, and requires clearance on the bottom only. The cutting tool, as shown in the side and front views, is located within a shallow channel in the face of the steel slide *C*, at *D*, and is held by means of the large cap screw *F*. The cutting edge of the tool is sheared off at an angle as shown in the front view, from *A* to *B*, so that it will remove the metal from the work progressively.

The circular portions of the two main castings, Fig. 2, are so constructed that the body of the tool can be swiveled, there being graduations at *U U* to enable it to be set accurately at the desired angle with the work. The base *J* is provided with a tongue *L*, which fits nicely in the slot for the tool post in the turret lathe cross slide. The main casting *I* is hollow in the center to allow a central hub of the base to project up through it. The bolt *K*, by which the base is secured to the cross slide, passes up through this hub and thus it is not necessary to loosen the base when swiveling the body casting or tool head. To set the tool head the two nuts *T T* of the base studs are loosened, and the head set by the graduations to the angle desired. The nuts are then tightened, and the head is rigidly held in position. The manner in which the two castings are finished so as to locate true with each other and swivel, is shown at *V V* in Fig. 2.

As a practical illustration of the manner in which the fixture is used, there is shown in Fig. 3 a plan view of it as located and fastened to the lathe cross slide, with the cutting tool in position for finishing from bar stock the taper end of a mild steel tool post. For this work a tailstock, equipped with center, replaces the turret usually employed and supports the end of the piece being formed and also acts as a gage for length.

In machining the part shown in Fig. 3, the stock is fed out the required distance, and the spring chuck jammed. The tail center, which is very hard, enters the bar far enough to support it. The handle of the fixture is then grasped by the operator and pulled downward until the lowest point of the cutting tool at *A* is somewhat near the center of the revolving

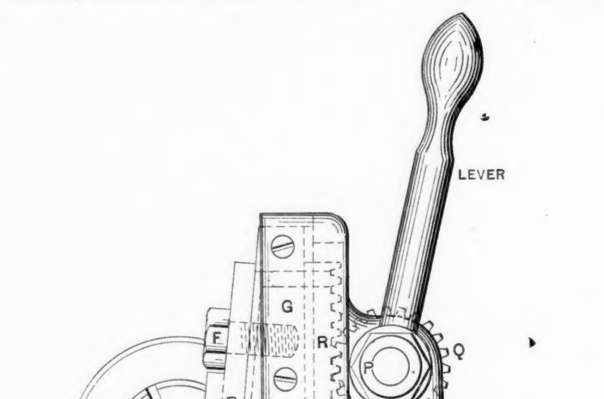



Fig. 2. Side View of Fixture.

stock. The cross slide of the lathe is then fed forward and the tool commences to cut until the slide stops against the stop screw, and the edge of the tool has removed considerable stock. The slide is now held securely against the stop screw,

by the operator pressing down hard on the cross slide lever; then with his right hand he pulls down on the tool head lever, thereby feeding the cutting tool downward, and the stock is gradually removed by the shearing cut of the tool and the bar is finished, as shown. As each portion of the tool's cutting edge removes the metal, it passes below the center of the bar and ceases to cut, so there is only a narrow surface of cutting

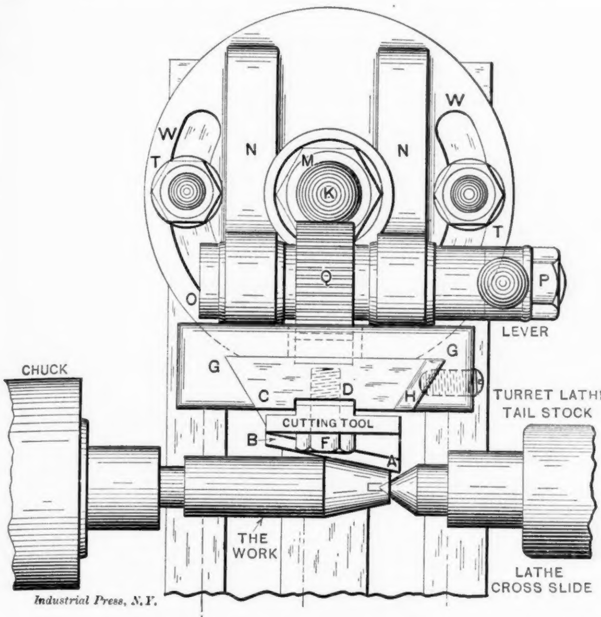



**Fig. 3. Plan View of Fixture showing its use for Machining the Taper Ends of Steel Tool-Posts.**

edge of the tool removing metal at the one time. The machining of the work is thereby progressive, there is no tendency to chatter or mark the work, and by having a good stream of oil constantly running on the work, a fine, smoothly finished surface is the result. As soon as the entire cutting edge of the tool has passed below the center of the bar, the lathe cross slide is fed back to its former position, and the cutting tool raised for the next piece. In order to produce the best results,

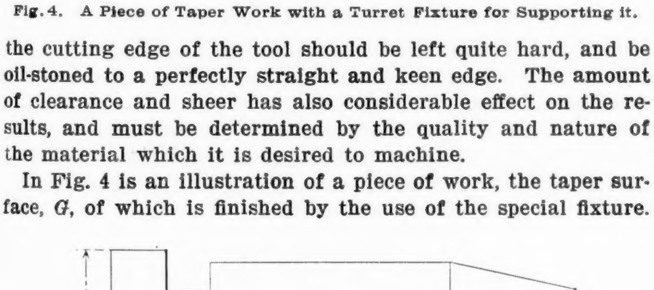



**Fig. 4. A Piece of Taper Work with a Turret Fixture for Supporting it.**

the cutting edge of the tool should be left quite hard, and be oil-stoned to a perfectly straight and keen edge. The amount of clearance and sheer has also considerable effect on the results, and must be determined by the quality and nature of the material which it is desired to machine.

In Fig. 4 is an illustration of a piece of work, the taper surface, *G*, of which is finished by the use of the special fixture.

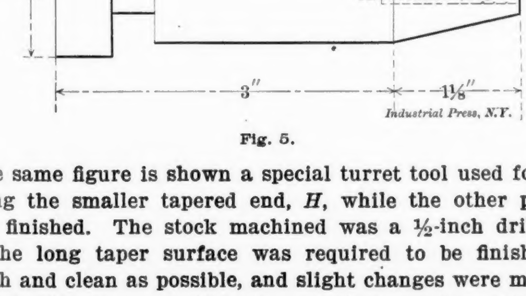



**Fig. 5.**

In the same figure is shown a special turret tool used for supporting the smaller tapered end, *H*, while the other part is being finished. The stock machined was a ½-inch drill rod, and the long taper surface was required to be finished as smooth and clean as possible, and slight changes were made in the tool slide to accomplish these desired results. The slide

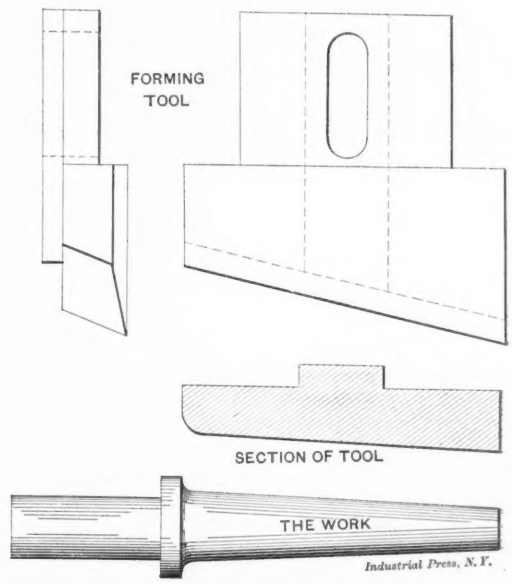



**Fig. 6. Example of Work, with Sketch of Forming Tool.**

*C*, of the fixture, Figs. 1 and 2, was replaced with another that differed from the first only in that the face was left straight and at a right angle with the cross slide, instead of being inclined for back clearance. Thus, when the edge of the cutting tool passed by the center of the stock, the portion machined would rub against it, and with the stock rapidly rotating the friction was sufficient to give quite a polish to the machined surface.

In Figs. 5, 6, 7 and 8 are shown four samples of work, the formed surfaces of which were machined by the use of the fixture here shown, and in Fig. 6 is a sketch of one of the cutting tools used for them, from which an idea of their construction may be gained.

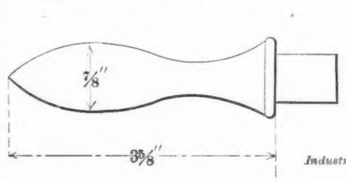



**Fig. 7.**

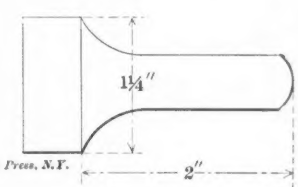



**Fig. 8.**

The great saving in producing work of this class direct from bar stock in preference to using separate castings, has made the turret lathe as great a factor in the production of machine parts as the engine lathe. For that reason any method or device which will add to the capacity of the machine, and increase the efficiency of the output, should be adopted, and the fixture herein described is one which will do this. It can easily be adapted for work other than of the class shown, such as chandelier and electrical fixture work, where large quantities of ornamental knobs, joints and various other parts are produced from large brass rod or bars; and in fact, for producing shaped pieces from the bar of steel, brass, fiber or hard rubber.

* * *

A remarkable smelter stack was lately illustrated and described in the *Scientific American*. It is built of wood and lined with corrugated iron. The flue is 10 feet square and 180 feet high. The stack is secured against overturning by an elaborate system of inclined wooden bracing. It cost about $10,000 Mexican currency, as against $40,000 if built of brick. The smelter is located at Mapimi, Durango, Mexico, at considerable distance from any brickyards and in a locality where wood is cheap. Of course, the chief menace is from fire. Platforms are erected every 40 feet in height for fire-fighting purposes. The chimney has been in use for three years, carrying off the arsenical fumes from six 60-ton blast furnaces.

* * *

The General Electric Co. have 60 molding machines in use in their foundry at Schenectady and are constantly adding more. When first introduced they were not entirely successful, but since the operators have become familiar with them the machines have been operated with great economy.

## KEYSEATING TOOL.

### A NOVEL TOOL FOR MILLING KEYWAYS, DESIGNED FOR USE IN THE DRILL PRESS.

The subject of the illustrations, Figs. 1, 2 and 3, is a keyseating tool for milling keyseats in gears or pulleys. It is designed to be used in the drill press, the fixture or holder carrying the milling cutter being supported and the cutter rotated and fed through the work by the drill press spindle. In Fig. 1 is a general view of the tool with the parts assembled. The cutter is carried by the cylindrical holder *T* and is driven by the spindle *S*, which is held in a chuck on the drill press spindle, or may be made taper to fit the Morse taper socket in the end of the drill press spindle, or a collet for the same. The method of driving the cutter is novel. In the lower end of the spindle *S* are inserted six hardened pins, shown at *P* in Fig. 2, which project slightly from the end of the spindle and have rounded ends. These pins fill the office of gear teeth and mesh with the backs of the teeth of the milling cutter, the cutter being driven by direct contact with these pins. The handle *H* is for the purpose of preventing the rotation of the holder *T* when grasped by the hand or made to bear against some stationary object.

This tool was designed by Mr. W. L. Schellenbach, of the National Machine Tool Co., Cincinnati, O., and is used for keyseating the gears for the variable-speed countershaft manufactured by this company, to which reference was made in the last number of the paper in connection with a description of a set of turret tools for machining the gear blanks. These gears have holes through the hubs 3½ inches in diameter, which is unusually large for the sizes of gears used. The diameter of holder *T*, Fig. 1, is 1½ inches and the cutter is so located that it projects ¼ inch beyond the outer cylindrical surface of the holder. If the tool were used for keyseating a gear having a 1½-inch hole, therefore, it would be attached to the drill spindle, the drill press started and the tool fed through the hole in the gear wheel by advancing the drill press spindle either by hand or power. As the body of the holder *T* would just fill the hole in the gear, the keyway would be milled ¼ inch deep and of a width equal to the width of the cutter. In keyseating the gears for the countershafts, however, the holes are so large that a bushing must be used for guiding the tool and this is shown at *B* in Fig. 1. The hole through which the keyseating tool is to pass is located eccentrically and breaks through the outer edge of the bushing, making a slot through which the cutter can project as it is fed through the bushing and mills the keyway in the gear.

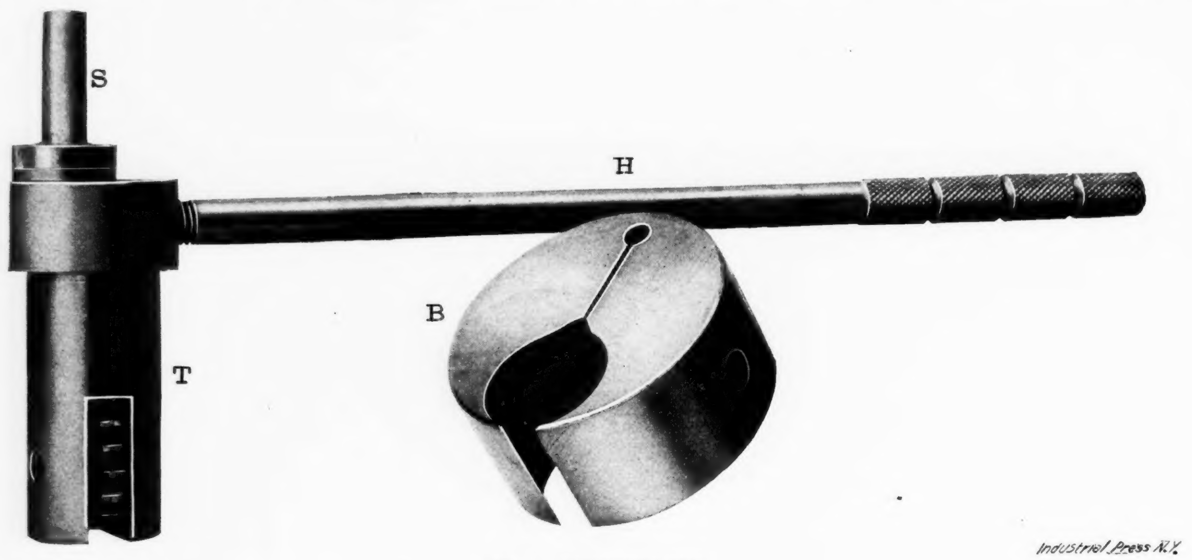


Fig. 1. Keyseating Tool.

In Fig. 3 are sketches of all the parts of the tool in detail and they are so clearly represented that further description is scarcely necessary. In fact the sketches tell the story more accurately and completely than would be possible by any worded description. The spindle has an annular groove at *K*, Fig. 2, and the holder has a slot cut to correspond, for the insertion of a key, shown in the end view at the left in Fig. 3, and which extends into the groove in the spindle and prevents end motion of the latter. The key is driven snugly into place and is retained by friction. It will be observed that the direction of rotation of the cutter is such that the cutting edges advance in the same direction as the feed; that is, the cut is with the feed. To prevent chattering and to break up the chips every other tooth of the cutter is grooved at the center and the intervening ones are cut away slightly at their outer edges. One tooth therefore cuts at its center, the next one at its edges, and so on. The cutter does not rotate directly on the cutter pin, but instead a bushing, longer than the width of the cutter, is forced into the hole in the cutter and turns on the pin. This gives a good bearing for the cutter and prevents the latter from wabbling when rotating. The length of the bushing is equal to the width of the slot in the holder in which the cutter is located. At one end of the bushing is a shoulder and at the other a washer, of such thickness that the cutter is centered on the bushing, and it must rotate exactly in the center of the slot in the holder.

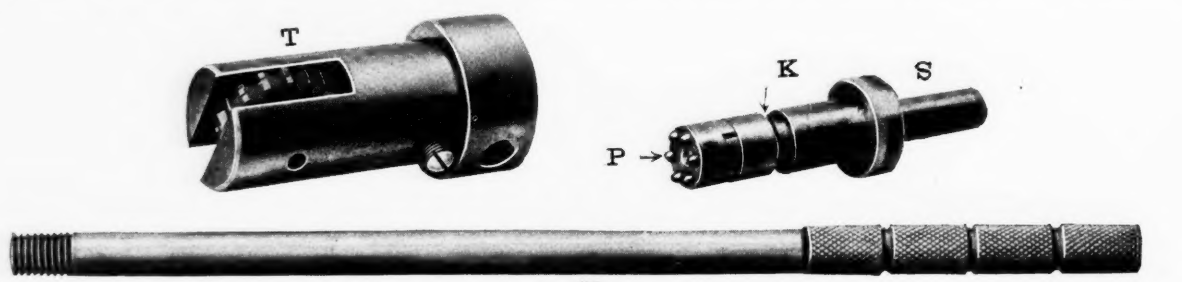


Fig. 2. Showing Spindle and Handle Removed.

This keyseating tool is not only a novelty, but it is efficient and convenient. The pins which drive the cutter do not wear excessively, as might be expected, and are so easily made that it would not be a serious objection if they had to be occasionally renewed.

## MARCONI'S ACHIEVEMENT.

### HIS INVENTION MAY POSSIBLY BE THE GREATEST OF THE PRESENT GENERATION.

The daily and technical press have already recorded the feat claimed by Marconi, the inventor of the wireless telegraph, of receiving messages from across the Atlantic by means of this system. While his experiments over so great a distance are as yet very incomplete, those of the electrical profession who are best acquainted with Marconi and are in a position to judge most correctly as to the value of his accomplishments, believe the signaling from Cornwall, England, to Newfoundland to have been successfully accomplished. On January 13th Marconi was the guest of honor at the annual dinner of the American Institute of Electrical Engineers, New York City, and many distinguished electrical engineers were present to welcome him and to hear his story of the development of wireless telegraphy. It is an interesting fact that 25 years ago the electrical engineers had as their guest of honor Cyrus W. Field, who did more than any other man toward laying the first Atlantic cable, and that the father of the recently-elected Mayor of New York City was toastmaster at the dinner in honor of Mr. Field. Marconi stated that there are now over 70 ships carrying installations for wireless telegraphy. Of these 37 are in the British Navy, 12 in the Italian navy and the remainder on the large liners such as the ships of the Cunard line. There are also over 20 stations in operation on land in Great Britain. It was explained that through experiments and improvements which have been made it is now possible to arrange the apparatus so that messages will be read only when the receiver and transmitter are attuned, it being impossible for apparatus not adjusted to intercept messages.

This perfected system is not at present in use on shipboard, as it has been deemed necessary that each ship should be equipped with apparatus permitting the operators to read a message sent from any other ship.

Marconi is modest in his bearing and says frankly that he has built very largely on the work of other investigators. He mentioned the names of Clark, Maxwell, Lord Kelvin, Professor Henry and Professor Hertz, to whom he felt deeply indebted and added that, as the message received at St. Johns was heard through a telephone receiver, the name of Alexander Graham Bell should also be included.

The following extract from an article in the Electrical World and Engineer gives several interesting particulars regarding Marconi's latest achievement:

"The readers of Sunday newspapers were treated with a sensation of the first order a few weeks ago by the announcement that Marconi had received during the previous week several signals at St. Johns, Newfoundland, transmitted from Cornwall, England. It now appears that before leaving England Marconi had made plans for accomplishing this result, though it was given out that his object in coming to Newfoundland was to establish a station for communication with ships at sea.

"The distance between the Cornwall station at Poldhu, Cornwall, from which the signals were sent, and that at Signal Hill, Newfoundland, where they were received, is about 2,100 land miles. The signals consisted in repetitions of three dots, corresponding to the letter "S" in the Morse code, and were audible in a delicate telephone connected with the receiving apparatus.

As previously stated, before leaving England Marconi had arranged with the electrician in charge of the Cornwall station, to begin sending signals daily after a certain date, which Marconi would cable him upon perfecting his arrangements at St. Johns. Signal Hill, at the entrance to the harbor, was selected as an experimenting station, and his equipment was installed there. On Dec. 9 he cabled the Poldhu station to begin sending signals at 3 P. M. daily, and to continue them until 6 P. M., these hours being, respectively, 11.30 A. M. to 2.30 P. M., St. Johns time. During these hours Wednesday Marconi elevated a kite with an aerial wire. He remained at the recorder attached to the receiving apparatus, and, to his profound satisfaction, signals were received by him at intervals, according to the programme arranged previously with the operator at Poldhu. These signals, as stated before,

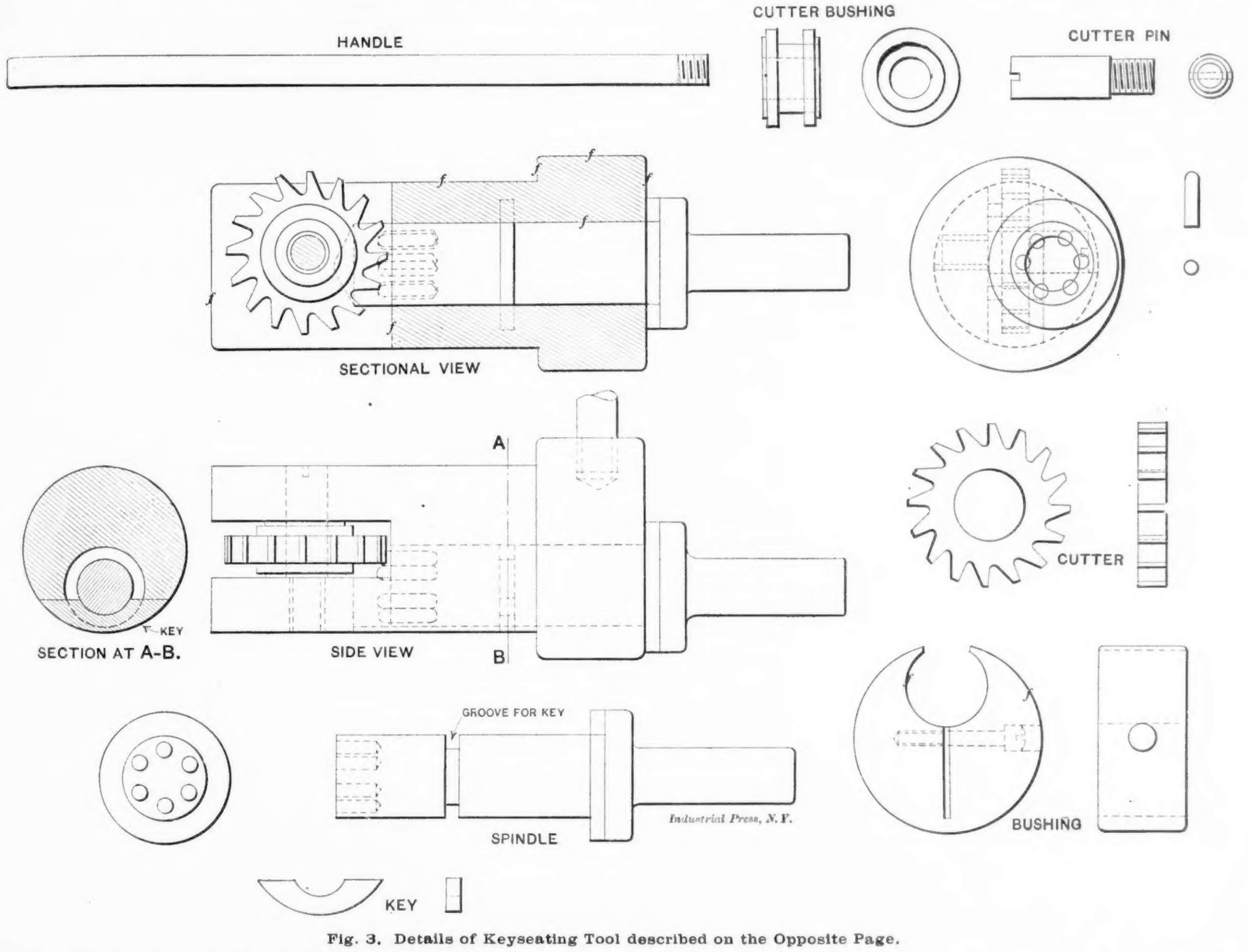


Fig. 3. Details of Keyseating Tool described on the Opposite Page.

consisted of repeating at intervals the letter "S," which is made by three dots, or quick strokes. This signal was repeated so frequently, and according to the detailed plan arranged to provide safeguards against possibility of a mistake, that Marconi was satisfied that it was a genuine transmission from England. Again on Thursday, during the same hours, the kite was elevated and the same signals were renewed.

"Though satisfied of the genuineness of the signals and that he has succeeded in his attempts to establish communication across the Atlantic without the use of wires, Marconi wishes it understood that the system is yet only in an embryonic stage. The possibility of its ultimate development is, however, demonstrated by the success of the present experiments with incomplete and imperfect apparatus, as the signals can only be received by the most sensitively adjusted apparatus, working under great difficulties, owing to the conditions prevailing at St. Johns.

"An unexpected development following the announcement of Marconi's success was a warning from the Anglo-American Telegraph Company that if he persists in his work in Newfoundland an injunction will be served. In a letter served on Marconi on Sunday the solicitors of the cable company gave notice on behalf of the company that the sole and exclusive rights to construct or operate any system or means by which telegraphic communication is obtained from any places in the colony, or within the jurisdiction of the government of the colony, to places outside of the colony, are owned by it; consequently they notified him that the work in which he is engaged is in direct violation of the rights and privileges granted to the company by its charter from the government.

"Mr. Marconi disclaims any intention of infringing upon the rights of the Anglo-American Telegraph Company. He states that he was aware that it has a monopoly there for two years to come, but thought that it was simply an ordinary commercial monopoly, by which no other company could enter into competition, and that he had no intention of competing in the ordinary business sense until their charter had expired.

"Dr. Pupin is quoted as saying that he fully believes that Marconi succeeded in signaling between the coasts of Newfoundland and Cornwall, England, by his system of wireless telegraphy. He states: 'According to the newspaper reports I have read the signals were very faint, but that has little to do with it. The distance, which is about 1,800 sea miles between these two points, was overcome, and further development of the sending instruments is all that is required.

"'One point which is of great value and interest to the scientific world is that Marconi has proved conclusively that the curvature of the earth is no obstacle to the system of wireless telegraphy. Some were inclined to think that the curvature limited the system.

"'All Marconi's efforts of late have been directed toward perfecting and making his sending apparatus more powerful and giving a greater height to the sending end. It still remains to be proved however, that heavy banks of fog, low hanging clouds and heavy showers along and in the path of the transmitted electric wave will not entirely obstruct its progress. The presumption generally is that they will, as experiments thus far have proved them so. Atmospheric conditions have also much to do with and strongly affect the electric wave.'"

* * *

## A SHORT TALK ON WRENCHES.

Along with an apprentice's "initiation" by the "gang" into the mysteries of the average machine shop are his lessons in the use of ordinary shop tools. There are, he often learns to his mortification, many wrong ways of using almost any tool, and usually only one right way. The apprentice's shop education consists largely of learning the right way. Even in the use of the often abused but indispensable monkey-wrench (not the "left-handed" kind) there is a right way and a wrong way to apply it to a nut, as every machinist knows. If he does not know it, his shop education has been sadly neglected.

A monkey-wrench applied to a nut in one way will stand a heavy strain without damage; applied in the opposite way and a much less strain may spring the jaws and ruin the tool. The right way to apply a monkey-wrench to *tighten* a right-hand nut or screw is shown in Fig. 1; the wrong way to *loosen* a right-hand nut is shown in Fig. 2. The wrench applied as shown in Fig. 1, with the force applied in the direction of the arrow, naturally rests against the nut at *A*. When the corner of the nut rests against the bar of the wrench at *A* the leverage of the sides of the nut to spring the jaws *B*

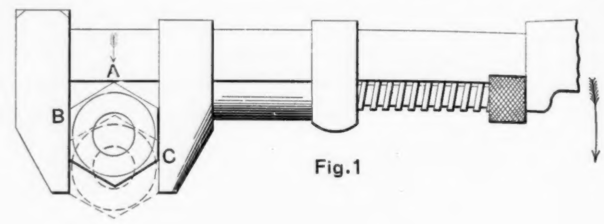


Fig.1

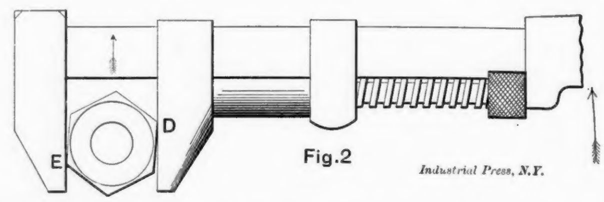


Fig.2

*Industrial Press, N.Y.*

and *C* apart is the least possible with that size of nut. It is quite plain that if the jaws are closed on a nut with the nut in the position indicated by the dotted lines, Fig. 1, the leverage of the nut to spring the jaws apart is greatly increased over that in the other position.

When the pressure is applied as indicated by the arrow in Fig. 2 the tendency is for the bar of the wrench to recede from the corner of the nut (or side, if it be square) and to thus increase the leverage tending to spring the jaws apart.

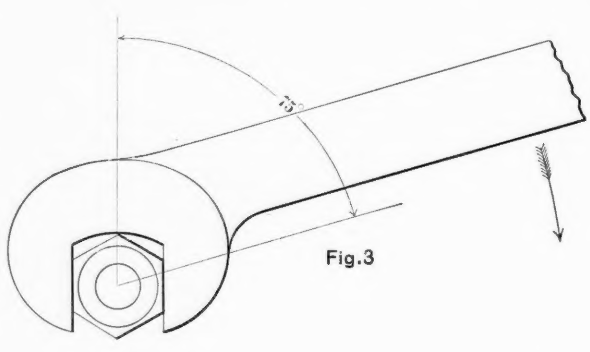


Fig.3

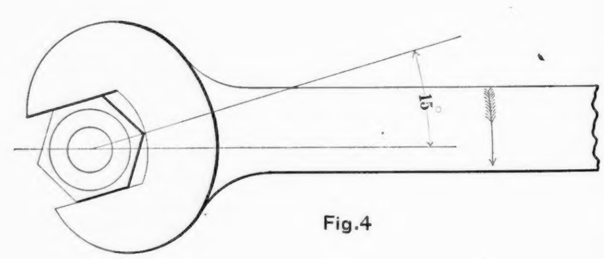


Fig.4

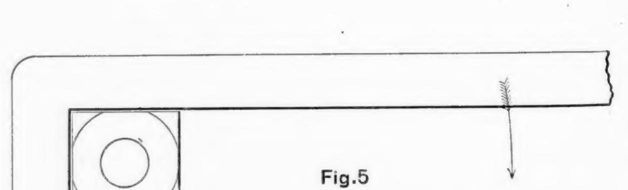


Fig.5

*Industrial Press, N.Y.*

As the jaws spring the nut slips further out between them and soon reaches such an angular position relative to the jaws that a wrench of many times the strength of the one in use would be required to stand the enormous stress. A six-sided or hexagon nut reaches such a position more quickly than a square nut, and for this reason a monkey-wrench is more easily sprung on a hexagon nut than on a square nut.

### Rules for the Use of Monkey-wrenches.

1.—Don't, if you can find a non-adjustable steel wrench that fits the nut and can use it.

2.—If you must use a monkey-wrench apply it so that the nut or screw will be on the side of the bar toward which the handle is to be turned.

3.—Always adjust the jaws on a nut as tightly as possible when first starting it, and be sure that the jaws go on as far as possible.

4.—A monkey-wrench is not a hammer; don't use it as such.

Drop-forged non-adjustable steel wrenches are now made in all ordinary nut and screw head sizes and in a great variety of styles. Figs. 3 and 4 show two models which are adapted to use in close quarters. With either style of wrench a hexagon nut may be turned when the angular distance through which the handle can be moved is only 30 degrees. The wrench shown in Fig. 4 may not, for the same dimensions, be so strong as Fig. 3 for the direction of stress indicated by the arrow, but it is stronger when both are under stress in the opposite direction. Therefore, since both are likely to be used in both directions, the model illustrated in Fig. 4 is preferable to that shown in Fig. 3. It is also more convenient to use.

The simplest form of wrench for square nuts is that indicated in Fig. 5. It is often employed on large heavy nuts, as it is easily and cheaply made and is much lighter for the same strength than an ordinary open jaw wrench. It must, however, be always used with the turning force applied in the direction of the arrow. In the opposite direction the jaw *A* is very weak to resist being sprung open by the nut. If always used in the proper manner the jaw *A* might just as well be shortened to, say, the length indicated by the dotted lines without in any way injuring it so far as its strength is concerned. It is thus made somewhat lighter and cannot be used in the wrong way.

* * *

## A SIDE-HILL SCALE.

W. H. SARGENT.

The accompanying drawings illustrate one of the peculiar conditions which are continually being presented to the Fairbanks Scale Co. in adapting their railroad track scales to

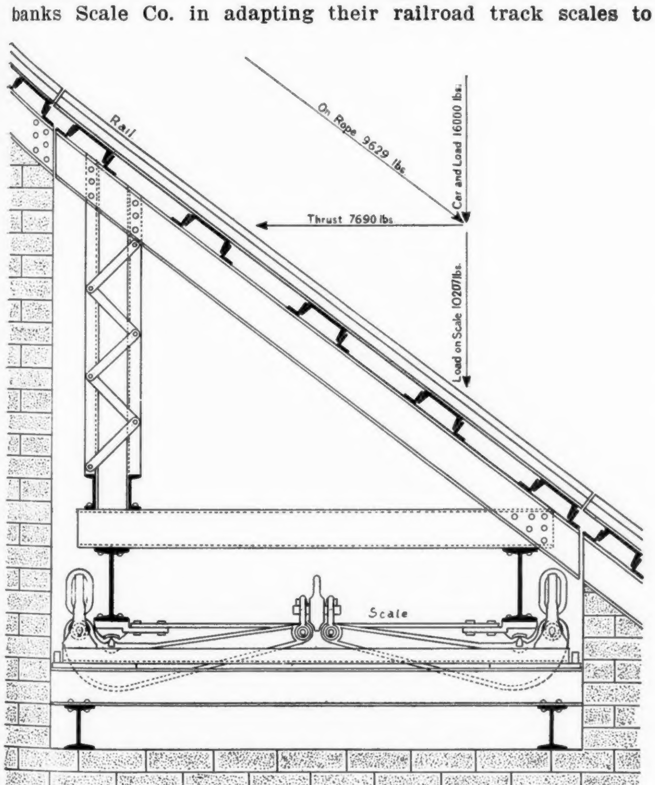



**Fig. 1. Scale for Weighing Cars on an Inclined Track.**

the demands of present-day business. This particular scale is located in a mine, and the grade is so steep that no locomotive can run over it; the load is, therefore, drawn up the incline by a rope attached to a hoisting engine. Now it is evident that under these conditions the entire load of the car does not come upon the scale, but that a certain portion of it is borne by the rope and that the process of weighing, if performed in the usual manner, will be in error by just this amount. It is possible, however, to so construct the scale that one-half or two-thirds or any other definite portion of a ton may be made to appear as a full ton; hence if we can only determine what proportion of the load is borne by the scale the mechanism may be made to indicate the entire load. This may be performed graphically by laying out a diagram in which lines represent loads and which then may be measured instead of weighed. In Fig. 2 is shown in full lines a triangle *A B C* representing the scale with the track *A C* at an angle of 37 degrees. Now from any point *D* on the line *A C* draw a line *D E* perpendicular to the base and 16 inches long. This 16 inches represents 16,000 pounds—the full load of the car—at a scale of 1,000 pounds to an inch. But this load is partly borne by the rope, pulling in the direction *C A*. From the point *E*, then draw a line *E F* parallel with *C A*, which will represent this load. These two motions—the downward tendency of the car and the pull on the rope—exert an intermediate pressure against the rail which would be represented by a line drawn from *D* at right angles to the rail *C A* and continued until it cuts *E F* at *F*. This we find to measure 12,788 inches, representing 12,788 pounds, and by scaling the line *E F* we find the load on the rope to be 9,629 pounds. Pulling on the rope also exerts a horizontal motion in the direction *G F* which is indicated as 7,690 pounds. We have now resolved the original load into several components and have determined the push and pull of each. There yet remains the question which we set out to solve, namely, what part of this load of 16,000 pounds is borne by the scale itself, and we will find an answer by scaling the line *D G*, which indicates 10,207 pounds.

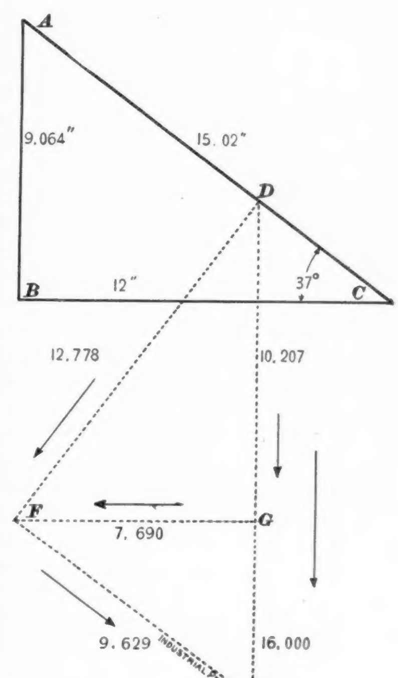



**Fig. 2. Diagram representing Loading o Scale.**

If the scale is therefore constructed and sealed so that 10,207 pounds on the platform will indicate 16,000 pounds on the beam, it is evident that all other weights will be in proportion and that the scale will weigh all loads correctly.

* * *

Combination machine tools are not often a success. In the machine shop of the Harrisburg Foundry and Machine Works there is a boring mill with a slotting attachment for cutting keyways in flywheels and pulleys. The attachment is not used, however, as it is not considered profitable. Instead a Colburn keyseater is mounted convenient to this boring mill and to another, and is used for cutting the keyways. Each boring mill operator not only tends his machine, but also attends to the keyseater when it is employed on the wheels he has turned. For this added service both employees are paid a small addition to their regular wages. The keyseater is not only much more rapid than the attachment to the boring mill, but its use enables the full capacity of the more expensive tools to be utilized every hour in the day, which is certainly the most economical principle in the operation of machine tools.

* * *

The coefficient of expansion of cement, as determined by recent tests, is from .0000053 to .0000057.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

FEBRUARY, 1902.



## REDUCTION IN PIECE RATES.

In the editorial in the December number of MACHINERY upon a Piecework Premium System, the statement was made that with any system of cost reduction it is generally assumed that the manufacturer will increase his profits through the introduction of the system. To this a correspondent takes exception, contending that in the long run it is the customer, not the manufacturer, who gets the benefit of the cost reduction.

He states that the tendency is for the prices of manufactured articles to decrease and that with improvements of the process of manufacture, more agreeable and convenient shop surroundings, and increasing skill on the part of the employés, the output per man will inevitably increase from year to year. Taking these facts as a premise, he contends that there must be a corresponding decrease in the price paid per piece for work, although the earnings per day or week will be as much or more, owing to the increased output; that no greater effort on the part of the workman will be required under the new conditions; and that this decrease must inevitably occur whatever system of wage payment is in vogue—whether a man is working by the day, or at piecework, or by the premium system. He illustrates these points clearly by diagrams drawn to show the relations between profits and wages under the three systems of payment enumerated above. These diagrams are reproduced in another column.

It was not our intention to imply that a cut in piece rates necessarily means an increase in profits solely to satisfy the manufacturer. Such, of course, might or might not be the case in individual instances, but as a general proposition it is undoubtedly true that wages, profits and selling prices are all so intimately related that they form a triangular "merry-go-round," with sometimes one and sometimes another ahead, but on the whole all keeping along together. Selling prices and wages are governed by the laws of supply and demand. They are both influenced by competition. The customer strives to purchase at a low figure and the manufacturer strives to keep down the cost of production to meet the demands of the customer as well as to secure his own profits.

We have no fault to find with the tendency to decrease the price paid per piece, because it is the natural order of industrial development that such should be the case. We do object, however, to the way in which such reductions are sometimes made. Automatic machinery and improved appliances are legitimate causes for such reductions; but where a workman, through extra effort, diligence or study is able to increase the output, it is not in the spirit of fairness to immediately cut the rate. He should be able to earn more under such conditions than when working by the day, and the price set should be high enough and allowed to remain long enough to compensate him for his efforts.

We believe that the piecework system offers the temptation to cut the rates unfairly where some other systems do not, and for this reason we suggested that it might be more equitable to incorporate with the piecework system some of the features of the premium plan of payment. Under the latter arrangement a man is guaranteed his day rate and is paid over and above this a certain percentage of what he earns if he produces more than a stipulated amount of work in a given time. By adopting a similar plan when paying for work by the piece, a frequent cut in rates—usually supposed to be inseparable from the piecework system—would become unnecessary, because the matter would automatically adjust itself and both employer and employé would receive his pre-determined share of the earnings.

* * *

## SECRETIVENESS REGARDING MANUFACTURING METHODS.

It is generally understood that most manufacturing establishments in European countries are not freely opened to outsiders, but, on the contrary, it is difficult for anyone not connected with a concern in some capacity to obtain admittance under any pretext. This policy is rigidly adhered to by the largest works, notably that of Krupp, at Essen, Germany, as well as the smaller ones. So when a European shop is found which freely affords opportunity to inspect its methods of manufacture it has departed from the established policy of exclusiveness which marks the great majority.

Some years ago a leading manufacturing company of the United States established a branch factory in France for making their products. Following their general policy as to shop hospitality all who were interested in their products and manufacturing machines and methods were freely admitted to the works and special pains taken to show them the improved machinery and the special appliances developed and in use for reducing manufacturing expense. The amazement of most of the French engineers who were granted these favors is said to have only been equaled by the appreciation of, to them, unexampled courtesy. They expressed their wonder as to the policy which made public that which would have been most zealously guarded in most French shops and regarded as an asset which would be lost if divulged to the public.

That the American company mentioned have not lost prestige or business by not following a policy of secretiveness goes without saying, and if proof were needed it is only necessary to point to the volume of business now transacted by them, which is many times that of the time when the French factory was opened. The secret of their success must, therefore, not lie in "keeping things dark," but undoubtedly in their policy of progressiveness which does not permit of standing still in the development of their product or of the machinery for its manufacture. It is said that this company and their allied interests spend annually not less than one-half million dollars in experiments and investigation work. Of course, the principal part they play in the development of machine tools is that of offering a ready market for any machine which increases productive capacity, and such should be the attitude of all manufacturers who are seriously in the industrial race.

A shop in which the policy and methods have crystallized into an unchanging form may be safely said to be unprogressive, and unless their product is of the nature of a monopoly the chances are that it will soon be left behind by more wide-awake and industrious competitors. Secretiveness as a shop policy may have certain advantages, but it is doubtful if they compensate for disadvantages thereby entailed which we need not enumerate. It is certain that such a policy cannot make up for progressiveness, and progressiveness seems impossible to any great extent when secretiveness is the rule.

## NOTES AND COMMENT.

John G. Sadlier, of the Springfield Foundry Co. and the Fairbanks Machine Tool Co., died on January 6th from a pistol shot inflicted by an employé whom he had previously discharged. At a very early age Mr. Sadlier was apprenticed in the shops at the Cambria Iron Co. Later on he was oreman for several large foundries in Ohio, and finally became a member of the Springfield Foundry Co.

Marcellus Hartley, president of M. Hartley & Co., of the Remington Arms Co. and of several other large firms engaged in the manufacture of fire arms, died suddenly in New York, January 8th. Mr. Hartley was born and educated in New York, and while still quite young became interested in fire arms. He thus acquired a knowledge which later was of great service to the U. S. Government, as during the late war the Secretary of War sent him to Europe to purchase arms for the Union army. Mr. Hartley was a member of many clubs, scientific and otherwise, and was also interested in numerous charitable organizations.

The electric power plant at Niagara Falls has been in operation eight years. If it were to be built to-day and the same thorough-going method used in its design and construction were applied to-day, the eight years of experience since that time would not enable the engineers to improve the plant to affect the cost of power one dollar per kilowatt year. This is the judgment of Mr. L. B. Stillwell, expressed in a paper recently read before the American Institute of Electrical Engineers. No better tribute could possibly be paid to the wisdom of employing the very best available engineering talent in important works involving large expenditures. As industrial progress brings greater and greater engineering problems in all branches of activity, this policy should be widely extended. In such busy times the temptation to provide for the present is very strong. A better policy is to look as far as possible into the future and secure the best because it will last and because it will be good while it lasts. There is little of the engineer's work which does not last many years, whether it is an electrical plant, a bridge, a tunnel, a locomotive or a shop.—*American Engineer.*

The work of the engineers in connection with the Niagara Falls plant appears to even better advantage when it is remembered how rapid has been the development of power plants and the use of electricity since the establishment of the station at Niagara Falls. Large direct-connected units, with a maximum of 2,000 H. P., began to be used about 1892, but the immense units of several thousands of horse power now running in New York City and elsewhere have come into existence within three years. They are made possible mainly by the perfection of the slow-speed generator and the improvements in forged steel engine parts such as are produced at Bethlehem and elsewhere. At the Niagara Falls plant the engineers were enabled to use large units with the massive rotating fields of the generators through the facilities of the Bethlehem Steel Co., which enabled them to forge immense field rings capable of rotating at high speed with perfect safety. In the matter of distribution of power it should be remembered that it is only about ten years ago that electrically-driven tools came into existence.

### THE NORTH GERMAN LLOYD'S AUTOMATICALLY-CLOSING BULKHEAD DOORS.

Recently an exhibition was given by the North German Lloyd Steamship Co. of a safety device that has been applied to their new express steamer, the "Kronprinz Wilhelm," in the way of a system of automatically-closing bulkhead doors, whereby all parts or sections of the hull of the ship may be instantly isolated from one another in case of collision or other accident to the vessel.

The hull of the "Kronprinz Wilhelm" is divided below the water line into 17 water-tight compartments, or bulkheads, and for ease of access between these there are provided 21 tight closing doors; it is upon these doors that the safety of the vessel after an accident depends, as if the compartment adjacent to the injured section of the hull may be perfectly shut off from the remaining compartments the ship may proceed to port in safety. In the system applied by the North German Lloyd, which is known as the Dorr system, the doors slide in vertical ways, and are closed automatically by hydraulic pressure controlled from an operating wheel on the bridge behind the pilot house. The system has been applied to the 21 bulkhead doors below the water line. In order to operate the wheel on the bridge, a trip lever has to be elevated out of the way to unlatch it, and by an ingenious ratchet arrangement, it requires some 20 seconds before the wheel is free to turn. While this lever is being moved, electric bells are sounded at every bulkhead door, giving warning for about 20 seconds before the doors begin to close from the action of the hydraulic cylinder, so that the attendants may get out of the way. The doors may, moreover, be closed by hand, independently of the hydraulic apparatus, and a lever is provided at each door by which it can be made to drop into its closed position almost instantly. An ingenious system of electric signals has been adopted in connection with the doors all over the ship.. In the pilot house is a large diagram, showing all the decks, and at each point where there is a bulkhead door a small bull's-eye is placed. Behind these bull's-eyes are signal lamps connected to switches at the doors in such a manner that whenever a door is closed the lamp is lighted. In this way the officer on watch has the position of the bulkhead doors throughout the entire ship directly under his eye.

It will be remembered that the "Kronprinz Wilhelm" is the latest addition to the high-speed fleet of the North German Lloyd Steamship Co., having arrived in New York on her maiden trip during September last.

### THE COOPER-HEWITT VAPOR LAMP.

Some new patents recently granted to Peter Cooper-Hewitt for improvements on his remarkable vapor lamp are again bringing before the minds of the public the question of the future possibilities of this form of electric lighting.

It will be remembered that the characteristic feature of the Cooper-Hewitt vapor lamp is the use of a vapor of metallic mercury as the conducting substance in the lamp instead of a solid conductor at incandescence as is used in the incandescent lamp; while its remarkable advantage from the commercial standpoint is the production of a given candle-power at about one-sixteenth of the cost of the same candle-power produced by incandescent lamps. In its usual form the lamp consists of a long glass tube containing a small amount of mercury at one end surrounding one of the inserted electrodes, the other electrode being inserted at the other end of the tube; but the size or shape of the tube is not fixed—many different shapes and sizes having been experimented upon by Mr. Cooper-Hewitt. It is also to be understood that while the tube is not rarified to a vacuum as is the incandescent lamp bulb, still it is exhausted to a very slight extent. The passage of a current through the tube causes the production of a very brilliant light and at a very low cost per candle power, but the light has a rather peculiar uncanny appearance which is stated to be due to the absence in its spectrum of the red rays of the solar spectrum. The light produced by this pure mercury gas comprises orange-yellow, lemon-yellow, green, blue, blue-violet and violet, but the absence of the red is said to render the light impracticable. The other disadvantage of this form of lamp from a commercial standpoint is the fact that the passage of current through it must be accomplished in starting by a high potential or other means of overcoming the high initial resistance of the conducting vapor, as a potential sufficiently high to maintain the flow after being started is far from being able to start. Also the temperature of the lamp rises to a very considerable extent when in operation as, in fact, the light-producing action seems to be substantially that of electric arcs in the conducting vapor, and it is indeed a question whether the glass of the tubes would be able to withstand the protracted heat in practical service without breaking or deteriorating.

An interesting exhibition of the Cooper-Hewitt lamps was made at the recent January meeting of the American Institute of Electrical Engineers. Lamps of the horizontal type of 600-candle power were shown in continuous operation and they naturally created a great deal of interest. The current by which they were operated was the standard 118-volt New York Edison lighting supply and the current consumption per candle power was found to be from 0.35 to 0.40 watts, which is only about one-twelfth of that required by incandescent lamps.

## ELECTRICAL OPERATION OF TOOLS.

ABSTRACT OF A LECTURE BY ROBERT T. LOZIER BEFORE THE NEW YORK ELECTRICAL SOCIETY.

At a recent meeting of the New York Electrical Society a paper was read upon "The Electrical Operation of Modern Tools and Machinery" by Robert T. Lozier, district manager of the Bullock Electric Mfg. Co., 220 Broadway, New York. The extracts from the lecture which follow bear directly upon the use of electric power transmission in machine shops.

Perhaps the most interesting feature of the subject is comparing the electrical operation of tools and machinery, either by a subdivision of the power, or individual application, with the old method of transmitting power from the main engine entirely by belts and shafting. At the present time the new shops that are driven entirely by belt transmission are in the minority and generally operate under conditions of such peculiar nature as to make the shaft and belt system particularly desirable.

At the meeting of the American Society of Mechanical Engineers in December, 1896, Prof. C. H. Benjamin read an exhaustive paper on the losses in the distribution of power in machine shops, giving the results of very thorough tests in 16 different establishments. The accumulated data are briefly summarized in the accompanying table, which shows that the

| | Length of Line Shaft. | Total H.P. | H. P. to Drive Shaft. &c. | Per Cent. | At What Capacity. |
|---|---|---|---|---|---|
| Wire Drawing and Polishing | 1130 | 400 | 157 | 39 | One-half |
| Stamping and Polishing | 580 | 74 | 57 | 77 | One-third |
| Boiler and Mch. Tools | 530 | 38 | 25 | 65 | Two-thirds |
| Bridge Machinery | 1460 | 59 | 48 | 81 | Nearly full |
| Heavy Machine Tools | 1120 | 112 | 64 | 57 | Full |
| Heavy Machine Tools | 1065 | 168 | 91 | 54 | Full |
| Light Machine Tools | 748 | 40 | 20 | 51 | Full |
| Manufacture of Small Tools | 500 | 74 | 40 | 54 | Full |
| Manufacture of Small Tools | 990 | 47 | 24½ | 51 | Full |
| Sewing Mchs. & Bicycles | 2490 | 190 | 108 | 57 | Full |
| Sewing Machines | 1472 | 107 | 75 | 70 | Full |
| Screw Machinery | 1800 | 241 | 114 | 47 | Full |
| Steel Wood Screws | | | | | |
| Manufacture of Steel | 674 | 117 | 17 | 14.5 | One-quart'r |
| Nails | 988 | 91 | 45 | 50 | Full |
| Planing Mills | 165 | 39 | 28 | 73 | Full |
| Light Machine Tools | 275 | 8 | 4 | 50 | One-half |

Average loss, 55 to 65 per cent.

average loss involved in the transmission of power represents from 55 per cent to 65 per cent of the total power generated. Say it is 50 per cent of the total power, then it will represent 100 per cent of the effective, or useful, power. If we have a plant of 100 H. P., and it requires 50 H. P. to operate the tools, and 50 H. P. to get the power to the tools, we are losing 100 per cent of the effective, or useful, power. And we must not forget that this loss is fixed and is not reduced as the load diminishes, so that if the useful power should drop to 25 H. P., this waste power would become 200 per cent of the effective power.

Prof. Benjamin in analyzing the distribution of power in the shop, says: "Stating the case roughly for the ordinary machine shop, every 100 indicated H. P. of the engine may be distributed thus:

| | | |
|---|---|---|
| Friction of Engine | 10 H. P. | or 10 per cent. |
| To drive Shafting | 15 H. P. | or 15 per cent. |
| Belts and Pulleys | 15 H. P. | or 15 per cent. |
| Empty machines | 15 H. P. | or 15 per cent. |
| Cutting material | 45 H. P. | or 45 per cent. |
| | 100 H. P. | |

"Even this efficiency would probably be realized only when all the machines were working at their full capacity."

He thus found the average loss in getting the power to the tool to be 55 per cent of the total, or 122 per cent of the effective, while in the test on the group system, operated by motors, taken on the basis of 100 feet of line shafts he found

| | | |
|---|---|---|
| Motor and Shaft | 12 H. P. | or 30 per cent. |
| Machines | 28 H. P. | or 70 per cent. |
| | 40 H. P. | |

It will be noted from the foregoing that driving and transmitting force is but 43 per cent of the effective, instead of 122 per cent in the case of all-belt driven. Prof. Benjamin does not state whether he has included in the motor unit its proportionate share of line loss, 5 per cent, and generator loss, 8 per cent. But these latter are more than offset by the circumstance of the tools being shut down when all loss is stopped.

Mr. Gano S. Dunn, in a paper presented before the American Institute of Electrical Engineers, on April 26th, 1899, put the problem as to whether it was advisable to use 100 feet of shafting driven by one motor, or three groups of 33 1-3 feet each, driven by three smaller motors, as follows: "Taking a duty of 1 H. P. upon the shaft for every five feet of length. corresponding to like machine-shop practice, and taking a coefficient of friction of 5 per cent, and a speed of 200 revolutions, transmitting 200 H. P. with the belts pulling horizontally in opposite directions, we find the per cent of saving in using three small motors, instead of one, is 2 per cent."

This is getting the question of economy down pretty fine. In this statement Mr. Dunn puts in the hands of the engineer means of determining how far the question of sub-division of the prime movers can be carried, purely from the standpoint of efficiency.

Of course, if a separate motor is applied to each tool, the loss in transmission becomes almost negligible, in spite of the theoretical losses that are sometimes attributed to the slow-speed motors that may be used in that system. In large plants in which the individual motor is freely applied it is found that the average load of the generating plant is but 1-6, or 16 2-3 per cent of the total connected load, including the electric lighting, cranes and trams; that is to say, if we have a plant, the motors and lights of which aggregate 1,000 H. P., it is not unreasonable to expect that the demand upon the generating plant will run about 166 H. P., and that this demand will not exceed the maximum of 250 H. P. for a considerable length of time; so it will be seen that a plant with such a large connected load can turn out its considerable product with a remarkably small expenditure of power.

Now what does this question of economy in power represent in dollars and cents to the producer? Prof. Chas. E. Emery, in his paper of March 23rd, '93, before the American Institute of Electrical Engineers, tells us that the costs of producing a mechanical H. P. are as follows:

With coal at $3.00 per ton for simple, high-speed, non-condensing engines, for 10 hours a day for one year (about 500 H. P. generated), $36.17 per H. P.; with special low-speed triple compound engines, $24.19 per H. P.

From these costs it is not difficult to determine what ratio the cost of power bears to the product of the shop which it drives. From empirical data I am able to state that the average ratios run pretty close to the following:

Complete Belting Transmission.

With the cost of steam power at $36.17, 2 per cent of product.

With the cost of steam power at $24.19, 1 2-3 per cent of product.

Subdivided Motors.

With cost of steam power at $37.17, 1 per cent of product.

With cost of steam power at $24.19, 0.8 per cent of product.

Individual Motor Drives.

Here the amount of power involved is so small as to increase the cost per unit, but I have known it to be less than 4 per cent of product.

Assume a locomotive shop, a large cloth-printing concern, or any other establishment in which a large amount of power is used in running its machinery to produce an output which we say amounts to one million dollars a year; and if we assumed that they use the very best methods of producing their power we find the cost of that power, per year, with the different methods above outlined, to be as follows:

| Method of Drive. | Cost of Power. | Yearly Saving. |
|---|---|---|
| All belts and shafting | $17,000 | |
| Sub-divided Motors | 8,500 | $8,500 |
| Individual Motors | 4,000 | 13,000 |

So that a sub-divided motor system saves enough over the old method of belt and shafting to pay 10 per cent yearly on a plant that would cost $85,000, and the individual motor ap-

plication could support, at that rate, a $130,000 plant. Of course the latter need not be entirely composed of individual motors, but groups of small machines can be driven by one motor whenever that method seems best.

From the foregoing figures we can tell, with reasonable closeness, what this subject of economy in power transmission means, and how far it will go toward representing the interest and depreciation upon the plant that it is necessary to purchase, in order to accomplish such savings. The figures are given from a broad standpoint; they have been gathered from actual plants now in operation and may be taken to fairly represent general conditions. So much for the question of economy.

In every line of the civilized world people are endeavoring to increase the sphere of action by increasing the quickness of operation. We use the telephone because it is quicker; trolleys because they are quicker; automobiles because they are quicker; and one of the greatest factors in determining the speed of the trolley and the automobile is the quickness of their control. The question is asked on every hand, What is the quickest method we can apply? not what is the cheapest in first cost, nor in which the smaller economies are apparent.

Let us, therefore, leave the question of what we are going to save in power transmission and other considerations of relatively minor importance and go at once to those matters of increased output and entire flexibility in the arrangement of the shop equipment.

It is true that the individual motor, properly controlled, can increase the product of an establishment. I have it on good authority from several sources where such equipments are used that the outputs have been increased from 8 per cent to 25 per cent with the same equipment and pay roll, due directly to the use of these motors, which many times are used in conjunction with a group drive system.

If it is true that with increased speed facilities we can increase the output, and we limit that output, in the case of the individual motor, to say 10 per cent, and that is low enough to cover the increase in most any kind of a well arranged plant, then let us consider the case that we took as a basis to determine the relative cost of transmitting the power—an establishment producing a million dollar product yearly. If we can increase this product by 10 per cent, we have $100,000 more with the same shop equipment and the same expenditure for fixed charges and pay roll. Allow for raw material, say $25,000, and we can credit the motor equipment with $75,000 a year.

This will probably more than pay for the entire equipment of individual motors in the first year, and in addition, the purchaser has the saving in power transmission, a free and clear head room permitting of the use of over-head cranes, which in these days of rapidly moving machinery we must have to handle the product. He is able to reorganize and rearrange his shop at any time, to remove old tools and make room for new.

To indicate the success of the individual motor in fulfilling all the demands put upon it, some of which have been almost abnormal, I will refer to the equipment of the shops of the Fore River Engine Co., of Quincy Point, Mass., a large establishment designed in accordance with the latest and best engineering practices and one in which the individual motor drive is giving a practical demonstration of its complete success.

This plant has a connected load, consisting of motors, arc and incandescent lights, of nearly 3,000 H. P. and its average load is about 260 H. P. This latter item may be increased as more work is put upon the tools. The load at present is distributed among 112 motors, half of which are of 5 H. P. or under. To get an idea of the service put upon an individual motor, I have here to-night some data on some very heavy turning work, and have samples of the chips. The tool was a 60-inch lathe, running with all back gears in head of lathe, the motor of 6½ H. P. capacity, operating at full line voltage. Results were as follows:

Photographs of the Fore River Engine Works were shown in the June, 1901, number of MACHINERY. The large lathes above referred to were built by the Fitchburg Machine Tool Works and illustrated in the September, 1901, number.—EDITOR.

Machining 20-inch steel shaft 32 feet long, weighing nearly 24 tons, taking two chips, one tool following the other. Feed was ⅜ inch. Cutting speed 18 feet per minute. Line voltage 235. Amperes, no load (rotating steel shaft only), 36; 12 H. P., or 66 per cent of motor load. Amperes with average load, 45; 15 H. P. or 250 per cent of motor load. Amperes with maximum load, 80; 26 H. P., or 433 per cent of motor load.

Owing to the excessive overloads it was necessary to change one set of brushes. It was, however, an emergency job, the motor was kept at its work, and Mr. F. O. Wellington, the general manager of the company, stated he believed it to be the quickest job ever done with so large a piece of material. The motor did not heat excessively, although it stood at over 300 per cent overload for periods of at least half a minute."

Mr. Lozier went exhaustively into the various methods of speed control, closing by saying that if individual motors were to be used it was of great importance that they be large enough, advocating a margin of at least 25 per cent over what was supposed to be a generous estimate.

* * *

## POWER TRANSMISSION WITH LOOSE BELTS.

There is a system of belt transmission in use at the works of the Tide Water Oil Co., Bayonne, N. J., which enables belts for the transmission of power to be operated satisfactorily when very loose on their pulleys. So far as we know the system is new. It consists, simply, in using a very loose belt to transmit the power and in running a narrow "keeper" belt on the outside of the main belt, the keeper belt being put on with about the same tension as ordinary tight belts.

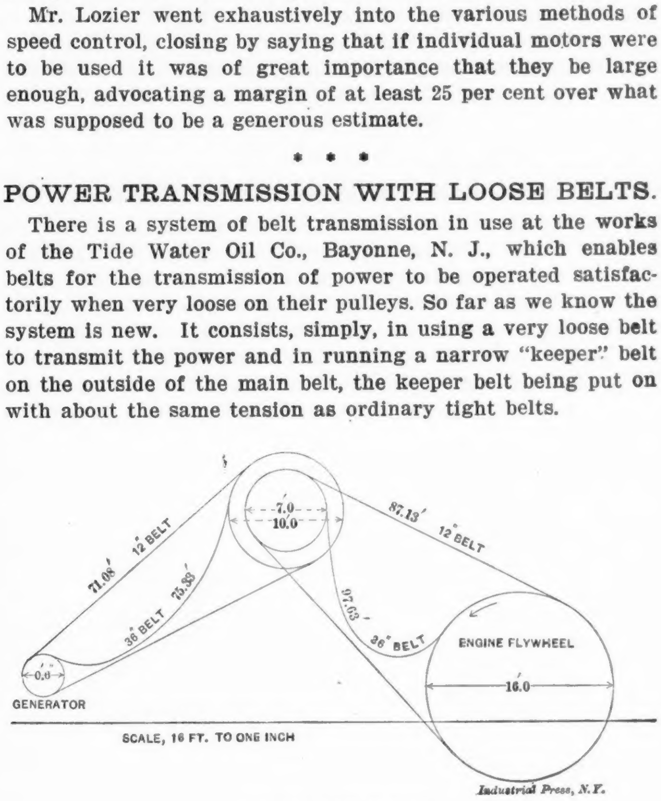



Diagram of Belt Drive.

The sketch shown herewith was furnished by Mr. J. E. Morse, mechanical engineer of the Tide Water Oil Co., and is a diagram of the belting from a Corliss engine to a jack shaft and from thence to a 250 K. W. three-phase generator. The main belt is 36 inches wide. The sketch is drawn to scale and it will be seen that this belt is very loose indeed. On the outside of the main belt is a 12-inch belt with sufficient tension to keep the main belt in close contact with the pulleys and to prevent the under or driving side of the belt from sagging. The belts are transmitting from 200 to 300 I. H. P. as the load on the generator changes and the engine is running 70 revolutions per minute, which gives a belt speed of 3,519 feet per minute. Assuming that the wide belt is transmitting all the power, which, of course, is not strictly true, one horse power is being transmitted per 420 feet belt speed for each inch in width of belt, when run up to the maximum capacity. This is a very creditable showing.

Mr. Morse writes that by this system he gets upwards of 30 per cent. more contact with the pulleys than where tight belts are used and that the trouble caused by stretching the 36-inch belts has been done away with and the life of the belts has been increased. Whether or not there is less friction in the bearings has not been determined with certainty.

The main object of the keeper belt in this case is to prevent the wide belt from jumping when starting and stopping, although the keeper adds largely to the adhesion of the inner belt and so increases the amount of power that a loose belt can transmit. In cases where the main belt is not heavy enough or the span between the pulleys great enough to enable a loose belt to transmit the desired amount of power,

the keeper can easily be proportioned to increase the adhesion between the pulleys and belt sufficiently to make the belt work as it should. In this connection it may be added that when a loose belt has once started to run smoothly there is a very marked tendency for the belt to hug the pulleys. In an installation of the Hill system of belt driving, in which binder pulleys are employed to increase the arc of contact on the pulleys, we have known of one of the binder pulleys being slacked off while the belt was running and the belt continuing to adhere to the face of the driving pulley for two or three minutes, and this, too, where the belt was nearly vertical. It would seem, therefore, that a loose belt may be made very efficient by the addition of a keeper belt, even when the distance between pulleys is not great enough for such a belt to carry the load under ordinary conditions.

* * *

## WAGES AND PROFITS.

A correspondent sends us the diagrams published herewith, showing the relations between profits and wages under day work, piecework and the premium plan of wage payment. These diagrams are drawn under the assumptions that the selling prices of manufactured articles gradually decrease, in the natural order of things, and that the capacity for doing work gradually increases among any class of workmen. Our correspondent writes, "Production increases as the result of many intangible things; for instance, better lights in the shop, better arrangement of tools, less delay in furnishing stock, better stock, better tools, better oil, higher speeds, greater cleanliness, and even good temper in the shop increase the speed of the work, while perhaps the workman sees absolutely no change. These improvements are going on continually with the progress of the age, so that almost every man is doing better than he used to, although perhaps he may not realize there are any changes in the tools or appliances he is using."

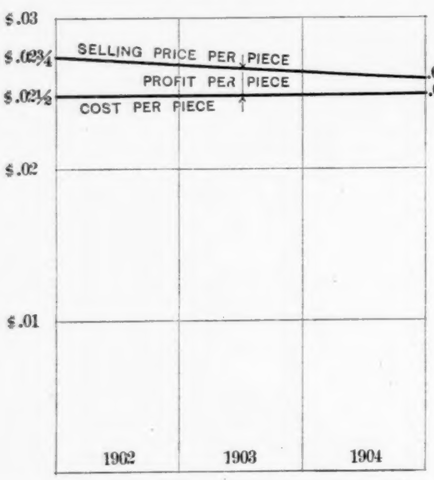


Fig. 1. Piece Work.

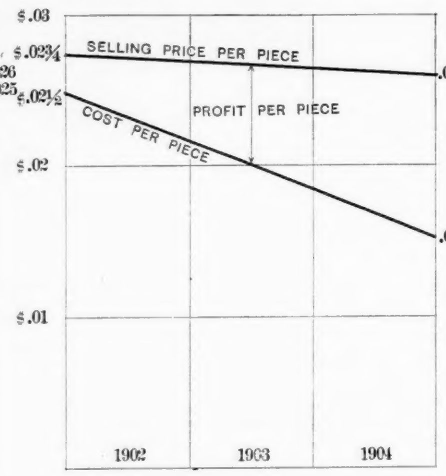


Fig. 2. Day Work.

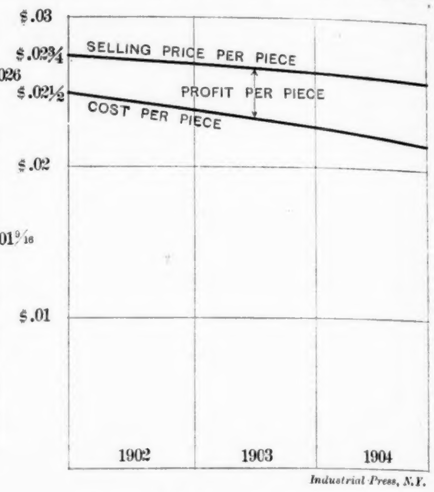


Fig. 3. Premium Plan.

First diagram shows:
*Piece work* with no cut in prices. Cost per piece remains constant. Selling price per piece gradually declines. Profit per piece declines rapidly. Must cut prices or lose profit or customers.

Second diagram shows:
*Day work* with no increase of wages at end of each year. Production gradually increases because of greater skill acquired, better tools and equipment, more sanitary surroundings, etc. Cost to consumer gradually decreases and profit to employer or customer rapidly increases unless the wages of the workmen are raised periodically.

Third diagram shows:
Compromise between *piece work* and *day work*. The wages per day are nominally the same but actually are gradually increasing. The profits per piece to employer or customer may be constant but are more apt to be slightly on the increase as shown above.

Fourth diagram (below) shows:
*L M* shows number of pieces per day resulting from a certain uniform effort. *A B C* shows daily earnings on *piece work* with no cut in prices. *A B D E F G* shows daily earnings on *piece work* with cut in prices, *A O* shows daily earnings on *day work* with no increase of wages. *A I D J F H* shows daily earnings on *day work* with increase of day pay at end of each year. *A D F K* shows daily earnings on *premium system* with no increase of day pay and premium equal to 1-3 of day pay. That is $O K = 1\text{-}3\ O C$.

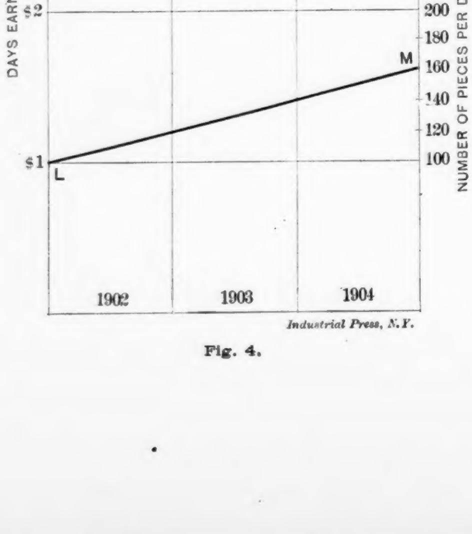


Fig. 4.

Under these conditions it is assumed that the price paid per piece must in consequence gradually become less, in order to meet competition, although the wages per day will not be reduced and in fact may and probably will become slightly higher as time goes on.

Our correspondent adds, "To express the matter by diagrams, we have sometimes said that if a workman worked at the same rate per day, and became more skilled, all the profit would go directly to the manufacturer or the customer; if he worked by piecework, all the profit would go at once to the workman, then he would be cut down and perhaps make a slight loss, to the advantage of the manufacturer; again, if the premium system were employed, part of the profit due to increased skill would go to the workman and part to the manufacturer or the customer, but even under the premium system, in time there must be readjustment to meet competition."

* * *

## AN ODD JOB.

E. N. L. writes: Some years ago a job came to my shop, a repair and machine shop, which several other shops had undertaken to do but failed. It was to cut a thread of four to the inch on the flat or face side of a 15-inch disk or faceplate. I simply constructed a bearing and bolted it to the back of one of my lathes, at right angles with the spindle. I also bolted temporarily a miter gear on the lathe faceplate, and one on the spindle at right angles, and to which the faceplate requiring the thread was fastened. It will readily be understood that by this means the rest of the operation was an easy matter.

# LETTERS UPON PRACTICAL SUBJECTS.

## A USEFUL AND INEXPENSIVE DRILLING JIG.

*Editor* MACHINERY:

The sketch represents a type of a drilling jig containing features that merit the attention of the jig designer. It may not be new to some, but on the other hand I have seen expensive and complicated jigs used where one of this type

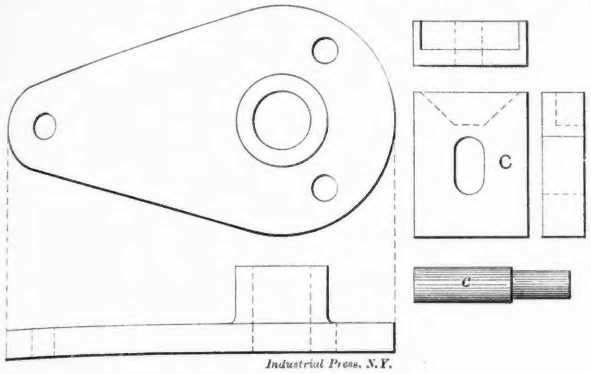



Fig. 1.

would have done as well. In our shop this type has reached a high state of development, due to conditions that favored the adoption of a cheap and quickly made jig, namely: A constantly changing product, the few pieces to be drilled and the fact that the jigs are always wanted in a hurry. In designing jigs under these conditions, the problem resolves itself into building a cheap jig and not accumulating a large number of useless patterns.

Fig. 1 shows the piece to be drilled. The plan and side views of the jig, with the work in position, are shown in Fig. 2, which shows sketch of the jig bottom side up. A cast-iron

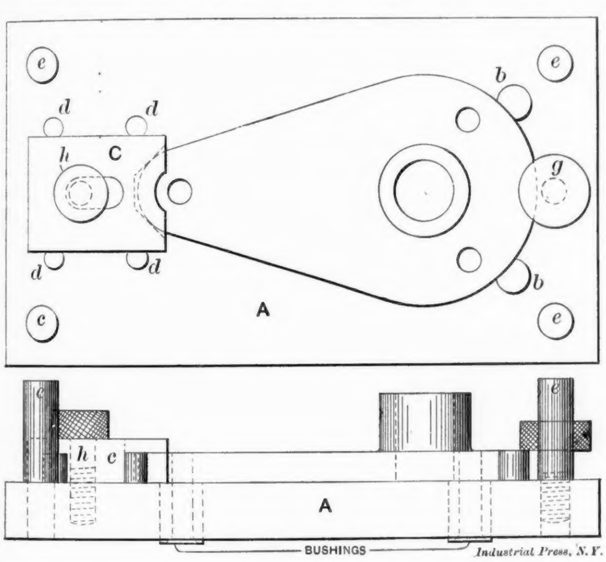



Fig. 2.

plate *A* is used, in which the required number of holes are drilled for the insertion of hardened bushings, and there are two locating pins, shown in the plan view at *b b*. *C* is a locating and clamping plate which is kept central by the four guide pins *d*. The V in the clamping plate locates the work in a central position, and as the plate also extends over the top of the work and clamps down upon it, it holds the work securely in place.

The work is bolted to the plate by the screw *h* on one side and by screw *g* on the other. The four legs *e* are shown in Fig. 2. The oblong hole in the plate permits the clamp to be moved back far enough to get the work in and out of the jig.

Large size plates, all planed up, are kept in stock so that pieces of the required size can be readily cut off when needed. This jig is very accurate, as with it the work can be brought close to the plate.

Philadelphia, Pa. LOUIS MYERS.

## FILING HARD CAST IRON WHEN RED-HOT.

*Editor* MACHINERY:

While reading the note on page 148, of the January issue, relative to the use of sulphur for softening hard cast-iron so that it may be readily drilled, another blacksmith's trick was called to mind which may be of interest to many readers, although it is an old scheme and one probably generally known by blacksmiths, if not by most machinists. It is for readily filing cast-iron which is too hard to be filed in the ordinary manner. Such iron may be readily filed when red-hot, and the amount of metal that can be removed in a short time in this way, using a coarse rasp, is quite surprising.

I first saw this kink used twenty years ago or more, while in a country blacksmith shop. The blacksmith was fitting a pair of new cast-iron shoes to a farmer's sleigh. The new shoes were of a considerably heavier pattern than those they replaced, consequently they projected considerably below the enlarged end of the wrought iron strap which passes up over the nose of the sleigh runner. To prevent the ends of the new shoes digging into the snow and also to make a neater job, it was necessary to remove about three-fourths inch of metal from the forward ends of the shoes, tapering back three or four inches to nothing. To file them cold was out of the question as they were very hard and brittle, being on a par with the iron commonly used in window weights and plow points. Being so hard and brittle it was also quite impossible to chip them with a hammer and chisel, so recourse was had to heating them and filing while red-hot.

The shoes were removed and heated in the forge to a full red, or possibly to almost a white heat. They were then removed and caught in a vise and vigorously attacked with a very coarse file or a fine horse rasp. Each shoe was filed down in this way in a short time, requiring, as I now remember, not more than four or five minutes for each one. I have never had occasion to file hard cast-iron in this manner, but once did try to file wrought iron while red-hot with no satisfactory result. Wrought iron is tough when hot, the same as it is at lower temperatures. Cast iron, on the contrary, crumbles readily at high temperatures, and for that reason readily yields to the file, even if it be of the hardest quality when cold.

F. EMERSON.

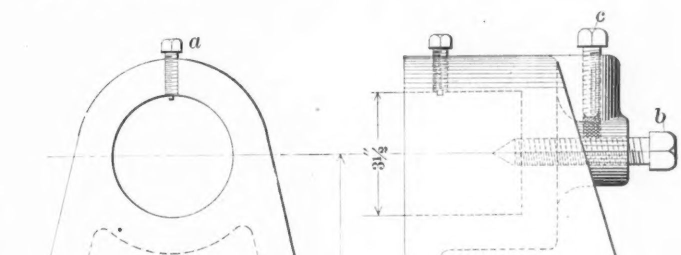
Newark, N. J.

* * *

## A TAILSTOCK FOR THE MILLING MACHINE.

*Editor* MACHINERY:

I had a gear of 3 pitch, 48 teeth, to cut on my milling machine, and the height to the centers of my dividing head and tailstock was but 5 inches. So I made a rising block to place under the dividing head and also a new tailstock, of which I send a sketch.




Tailstock for the Milling Machine.

I found this tailstock to be much superior to the tailstocks usually provided with milling machines. The bearing was bored 3½ inches and supplied with a number of bushings that were nicely fitted to the different sizes of arbors. The

bushings, when in place, were prevented from turning by a tit on the setscrew *a* which fitted a corresponding hole in the bushing. Setscrew *b* was used only for taking the end thrust, the support of the arbor coming wholly on the bushing.

Under the end of setscrew *c* was placed a piece of brass which was threaded to match the screw *b*. This enabled me to clamp *b*, when in place, without injury to the threads. The general construction of this tailstock will be clear from the sketch. H. R. ASH.

Chicago, Ill.

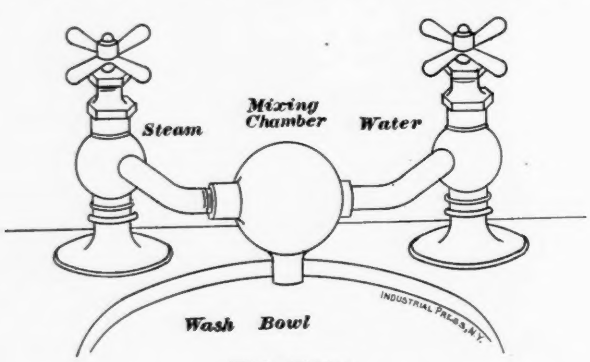
* * *

## A SIMPLE WATER HEATER.

*Editor* MACHINERY:

It is easy enough for a fellow to "get into hot water" figuratively speaking, but it is not so easy to get into really hot water when he wishes to get rid of some of the shop grease and dirt on his hands in order to handle a set of plans or look over several pages of specifications.

Hot water suitable for washing purposes is not often available around the shop or even in the office, but steam is usually at hand and the accompanying sketch shows an arrangement by which live steam may be mixed with cold water as it flows




Water Heater.

from the faucet, so as to make the water in the washbowl of any desired temperature. Two faucets, one for steam, the other for cold water, are coupled together after the fashion of a double bathtub faucet, except that the connection in the middle is much larger so as to permit the steam and water to thoroughly mix before passing out into the basin. The steam pipe, if small, should not run far to the source of supply or else the steam will condense and fill up the pipe with water, cold and not always clean. W. H. SARGENT.

St. Johnsbury, Vt.

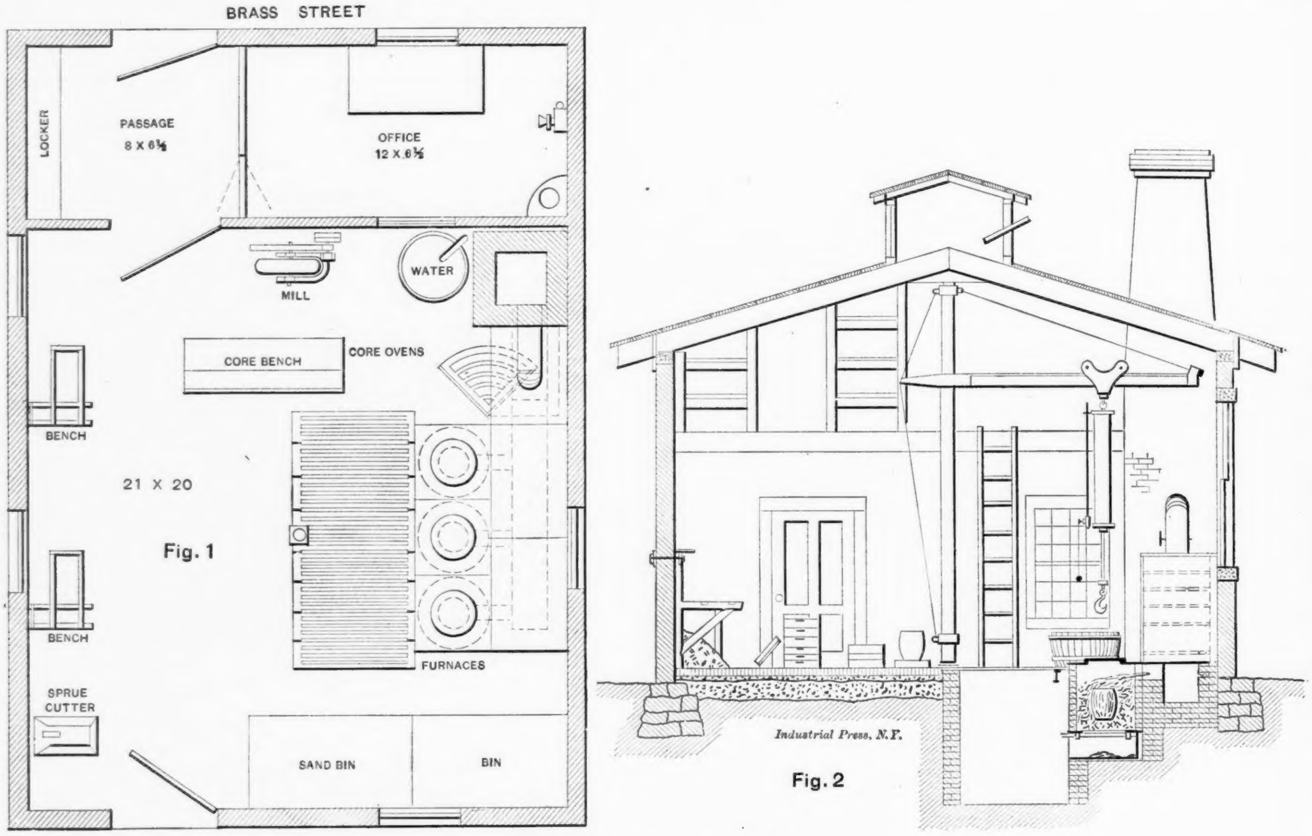
* * *

## EQUIPMENT FOR A SMALL BRASS FOUNDRY.

*Editor* MACHINERY:

I recently had occasion to estimate the equipment for a small brass foundry, and I send you the sketches of the plant which I designed, showing the arrangement. The building can be built of wood or brick, as desired.

Fig. 1 is a plan of the foundry, and Fig. 2 shows a sectional elevation. As will be seen in Fig. 1, the building is divided into two sections, the small one being used for an office and the larger for the foundry. In this foundry on the right are three furnaces, with a core oven built over the flue,




Plan View and Cross Section.

arranged with a sliding damper which takes part of the waste heat through it to dry the cores. On the left are the benches. Tubs are not much used; they are considered unhandy, as with them the sand cannot be as easily handled. The sand is tempered on the floor and then thrown back against the wall for further use.

One of the features introduced was a crane, with air hoist, so arranged that it could be turned around and cover nearly the entire floor, lifting the pots of melted metal from the furnace and removing the ashes from the pit.

Over the office is a loft with shelves on one side and a space for an electrically-driven air compressor with receiver to supply air for hoisting, dusting, rapping and chipping. The electric motor when not driving the air compressor is used to run the mill for grinding the cinders.

The sketch is of a small-sized foundry, but where more room and benches are needed the foundry can be enlarged in proportion. WM. F. TORREY.

Quincy, Ill.

* * *

## SPECIAL TOOLS FOR SMALL WORK.

*Editor* MACHINERY:

The tools described herewith recently came to my notice and impressed me as being very novel. All of them are of miniature proportions, but the amount of work they are capable of turning out is surprising. The first of these is a tool for cutting steel wire pins and is designed to be used in a power press. The pins are cut from wire, No. 53 B. & S.

gage, and are 1-10 inch long. The tool is shown assembled in Fig. 1, and in Fig. 2 are the parts in detail. The same reference letters are used for corresponding parts in both Figs. 1 and 2.

A block of tool steel, *B*, planed on all sides, serves as the bottom plate and is fitted into the die dish on the press. A lever *C*, planed 1-10 inch thick, the same as the length of the pins, is pivoted to the plate at *d*, and a block *E* serves to guide the lever. It is planed out underneath, forming a shoulder at *f*, to act as a stop for the lever, and the depth of the planed portion is 1-10 inch, so that when the block is fastened to the plate the lever will slide under the overhanging part and be free from shakiness.

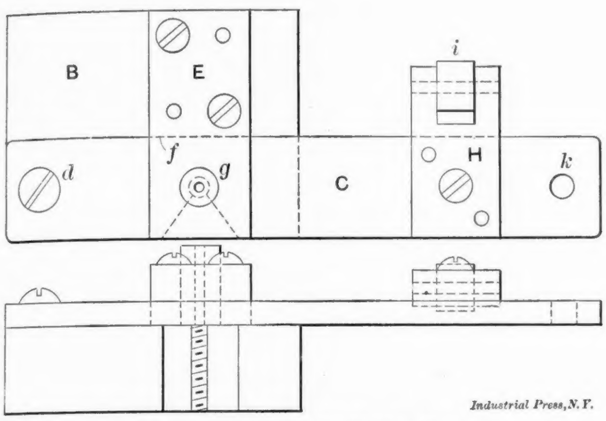



Fig. 1. Wire Cutter for Making Pins.

After the lever and block were fastened to the plate, a small hole was drilled through the block, lever and bottom plate while the lever was held firmly against the shoulder *f*. The block and lever were then removed, the hole was enlarged and a steel bushing *g* fitted in the hole in both the block and lever. A hole was drilled through the bushing in the block the exact size of the wire, and the hole in the bushing of the lever was drilled slightly larger to allow the pins to drop out after being cut. The bushings were then hardened, the one in the lever being ground flush with the surfaces of the same after it had been forced into place. The bushing in the block was allowed to project above in order that it might be forced down and reground when the cutting edge became dull. This bushing was also ground flush with the under surface of the block, so that when the latter was in place and the lever pushed in until it rested against the shoulder *f*, the two bushings would make a tight joint.

tached to the frame of the press and the other end to the lever at *k*.

The operation of the tool is as follows: With all the parts in place, the press is put in motion and a piece of wire to be cut is pushed into the hole in the bushing until it rests on the end of the screw *l*. The plunger descending, forces the lever outward and cuts the pin. The motion of the lever is continued far enough to allow the pin to slide by the screw, when the pin drops out and falls into a box provided for it. The plunger ascending, the spring pulls the lever back to receive another pin, which is pushed into place while the press is passing the center.

The second tool is for punching ferrules, one of which is shown full size at *a* in Fig. 3. The outside of the ferrules is tapered and there is a straight hole through the center. The base *B* of the tool was turned and bored, or countersunk, to receive the bottom plate *d* and the die *c*, and a hole was drilled through the base so that the bottom plate could be driven out if necessary. The lower end of the hole in the die was made of a diameter and taper corresponding to the outside diameter and taper of the ferrule, and the punch was designed to fit the upper part of the hole, and it extends into the hole far enough to compress the metal forming the ferrule to the correct shape and height.

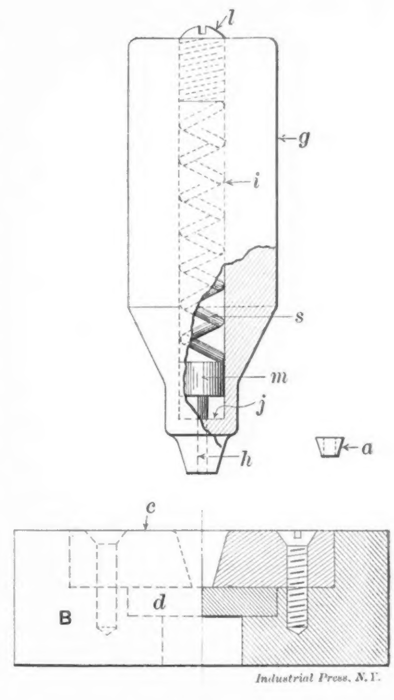



Fig. 3. Punch and Die for Making Ferrules.

After the end of the plunger was turned to the right shape, a hole *h* was drilled in the small end, equal to the diameter of the hole in the ferrule, and a hole *i* was drilled from the other end down to the point *j*, and tapped for the adjusting screw *l*. The plunger was then hardened and the temper drawn very low, to prevent breaking. The plug *m* was finished, one end being turned to fit the small hole in the plunger and the other end to fit the larger hole. The length of the small part of the plug is such that when the large part or head rests on the bottom of the large hole at *j*, the small end will project through a distance equal to the length of the ferrule. This plug is continually pressed downward by the spring *s*, the tension of which can be adjusted by screw *l*.

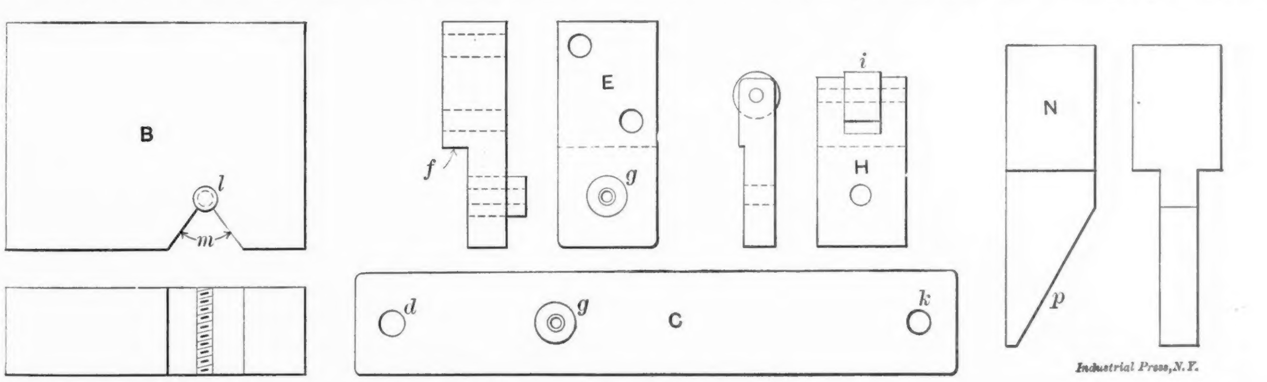



Fig. 2. Details of Wire Cutter

The small hole drilled in the bottom plate to correspond with the hole in the bushings was then enlarged and tapped for the screw *l*, which was made of steel and hardened and ground even with the top of the plate *B*. The bottom plate was finally cut away as indicated at *m*, in Fig. 2.

A small block *H*, carrying a roll *i*, as indicated, was fastened to the outer end of the lever by a screw and dowels. This roll is to take the thrust of a plunger *N*, Fig 2, fitted to the ram of the press. The plunger is hardened and has a beveled edge *p*, which acts as a cam surface. When the plunger descends, this surface bears against the roll and moves the lever outward; and as the plunger ascends, the lever is returned by a spiral spring, one end of which is at-

The ferrules were first drawn of flat brass, on an arbor, through a plate on the draw bench, and were then sawn into equal lengths about 1-16 inch longer than the finished length of the ferrules. The tools having been set in a hand press, one of the brass pieces was placed on the small end of the plug, the arbor lowered, and the piece forced into the die.

When the plunger was raised the ferrule could be easily removed from the plug. This tool performed the work perfectly and withstood breakage.

In the shop where these tools were found there were a great many small holes to be tapped, for small screws like watch screws, and a sensitive power tapping arrangement was constructed like that in Fig. 4, after considerable experimenting. The sketch shows the machine about two-thirds size. The head frame is similar to the head of a small bench lathe and sets on the bench upon short legs. The head is fitted with brass bushings *c c*, in which the spindle turns. The bushings extend inward toward the center of the head and also

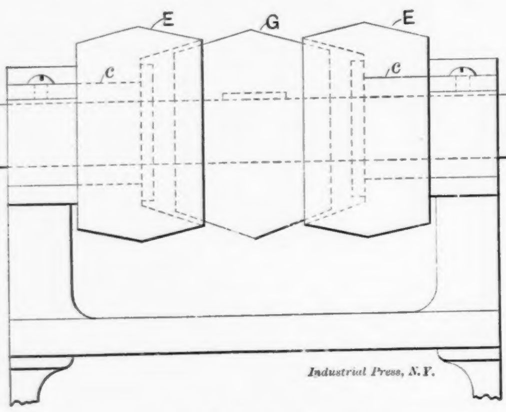



Fig. 4. Tapping Machine.

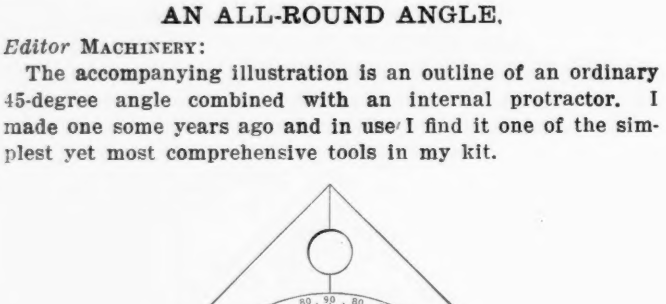
furnish bearings for the pulleys *E E*, the pulleys being retained in place by a shoulder on the inner end of each bushing. The pulleys are of cast iron and are bored taper to fit a double friction cone *G*, keyed to the spindle. The end of the spindle is turned to fit a small chuck in which the taps are held. Open and crossed belts are used, as with any tapping machine, and the design of the taper friction surfaces is such that, by pressing against the end of the tap very lightly with the work will cause the spindle to revolve and the tap to enter the work. Upon pulling backward the other pulley engages the friction and reverses the motion of the spindle. A number of these machines are now in use, some being arranged as a lathe with a sliding foot stock, having plates to which the pieces to be tapped can be attached, to guard against tapping the holes out of line. NOTROH.

* * *

## AN ALL-ROUND ANGLE.

*Editor* MACHINERY:

The accompanying illustration is an outline of an ordinary 45-degree angle combined with an internal protractor. I made one some years ago and in use I find it one of the simplest yet most comprehensive tools in my kit.




An Angle-Protractor.

The advantage of an internal or open protractor is self evident. An outside or covered protractor, which is the usual design, reminds me of the man who was always in his own light. An open or internal protractor is never in its own light inasmuch as in no part of its 180 degrees is the area covered from center of circle to arc of protractor.

The first one of this kind I made was of Bristol board, about 3½ inches in diameter and was used in laying out the complicated angles of a bicycle frame. The angles were given in degrees and parts of degrees, the latter being estimated and I was informed later that every part came together exactly right, without any variation from the angles specified on drawings. A very accurate method was used to graduate the protractor, however.

It will be observed that holes are made in the corners of the instrument to hang it up by.

If I were to construct a more elaborate protractor I would add a vernier plate and make the protractor circle so that it could be moved some specific part of a degree; also would make it as large as convenience and utility dictate, for greater accuracy.

This angle-protractor is especially useful in laying out the angles of bevel or mitre gear blanks. I well know that some of our mathematical friends, who do everything by figures, furnish us with tables and formulas for the angles of bevel or mitre gears; but I have run against some of these men who are particular to figure the outside and pitch angles but neglect to give in their tables or drawings the cutting angles by which the gear cutter man can set over his machine to cut his wheel correctly. To set by the outside angle or the pitch angle is not right. The most essential feature in constructing bevel gears is that each be cut at its own correct cutting angle so that when cut and placed tight together, tooth into space, and an accurate try-square is used to test them on the rear ends of the hubs, they are found to be square because correctly cut.

Figures are all right if the figurer figures correctly; but if the figure man uses the wrong figures, he "don't get there" any more than the man does in attempting to get into a safe when he don't know the combination. F. W. CLOUGH.

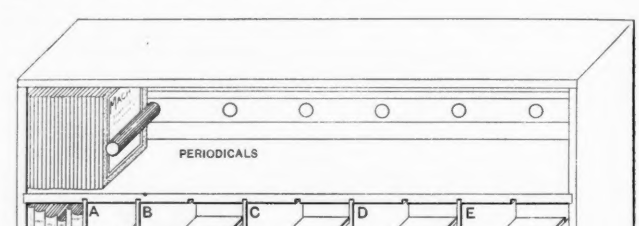
Springfield, Mass.

* * *

## A HANDY CATALOGUE CASE.

*Editor* MACHINERY:

Catalogues being a necessary and handy reference, it is very desirable that they be arranged and kept in such a manner as to be easily found. Being myself in need of some sort of case for this purpose, I devised the one shown herewith, and it has proved a great success, enabling me to find the catalogue I want in the minimum of time.




Shelves for Catalogues.

The sketch will no doubt explain the method of construction sufficiently, but there are one or two points in connection with it worth pointing out. In the first place, it will be noticed that the various divisions are flexible, the partitions being slipped into the grooves made to receive them. These partitions are ¼-inch thick. This enables you to increase the capacity of any one letter when necessary. The distance from the front to back board of cabinet is 12 inches, and the grooves for the reception of partitions are cut to about one-half that. On the outer edge of these partitions I put pattern letters in order to alphabetize the catalogues as they arrive. I have it so arranged that all the space on the left of any partition contains catalogues, the titles of firm names of which commence with the letter on the partition.

The upper shelf has no top to it, and can be used for holding papers of various heights. These can be held in position by means of say, six wooden pins, which are made to fit snugly into the holes shown in back board. The lower portion of the cabinet can be used for boxes containing various samples, the 2-inch base board keeping same in place and keeping out dirt, etc. This board is fastened by two screws as shown, one on each end, which enables one to easily remove same in order to clean out when necessary. ROBT. A. LACHMANN.

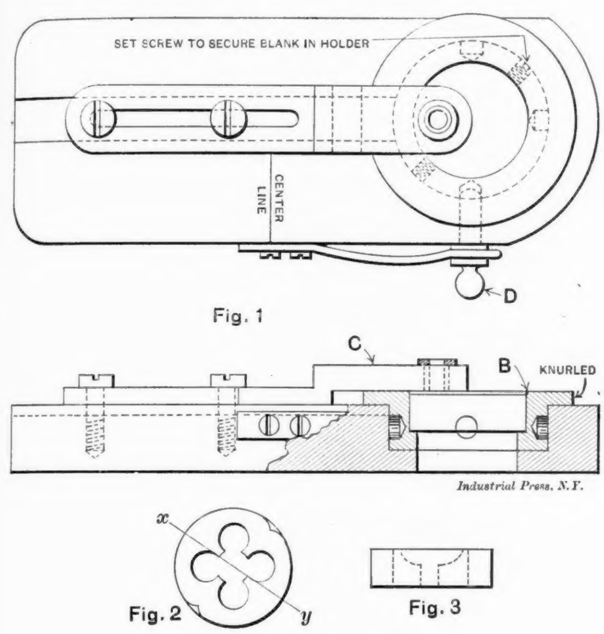
Chicago, Ill.

* * *

## JIG FOR SMALL THREAD DIES.

*Editor* MACHINERY:

The accompanying sketch, Fig. 1, shows a jig for spotting and drilling small thread dies. The die blank is placed in holder *B*, being secured therein by the setscrews located as shown. This holder is readily rotated, as it is knurled on the edge of the flanges. It has four equally spaced locating holes, into which locating pin *D* enters. The slide *C* can be adjusted to spot holes at different radii from the center of the blank, and will locate the center hole in the blank when the mark on the slide coincides with the "center line" graduation on the holder plate. After the blank is properly spotted the holder may be removed from the plate and used to hold the blank while it is being drilled.




Spotting and Drilling Jig.

A few "kinks" about the making of these dies may be useful. The die will cut at its best when the cutting faces of the teeth are on the center line, as shown in Fig. 2. If the die strips thread off piece it is probably due to its having too much width of tooth, thereby causing too much friction; or that the cutting faces of the teeth are not on a center line, thus causing the die to drag. If the threads on the piece cut have not the correct angle the die has probably warped in hardening. Throw it away; there is no remedy. For fine threads the die should be countersunk as shown in Fig. 3, and ought not to have more than six to ten full threads, thereby reducing friction.

When a blank is tapped be sure to place lead on the opposite side from which the tap enters, as it will be found that the threads in the rear end will be truer to size and cleaner cut, and also that there will be a slight taper from the lead side, giving the threads a good clearance. Dies should be split and wedged to bring the cutting sizes up good and full.

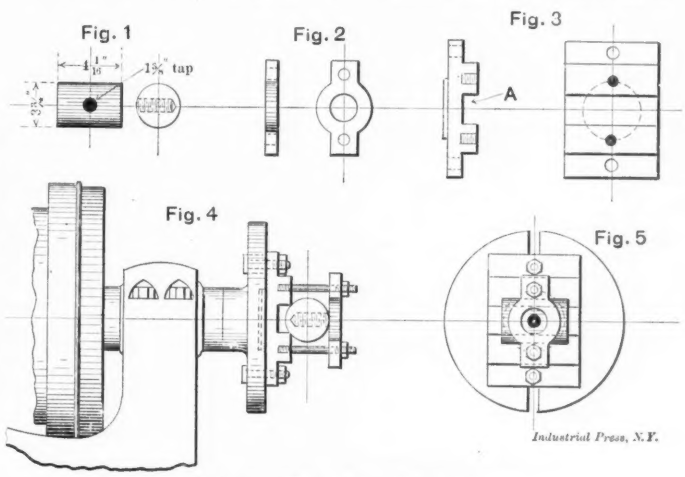
I. B. NIEMAND.

* * *

## DRILLING AND TAPPING PINS.

*Editor* MACHINERY:

I send sketch and description of a fixture for drilling plunger bearing pins, of the Laidlaw Dunn Company's type, which I think could be used for a good many jobs of a similar nature. One of the pins to be drilled is shown in Fig. 1. It is essential that the 1⅜-inch tapped hole shall be placed exactly central with the sides of the pin and at right angles to the surface. Angle irons, used for other faceplate jobs, were first tried and later V-blocks, but without success, owing to the tendency of the pins to move out of position while being drilled and tapped; so the method shown below was adopted. A counterbore was first made in a faceplate and a casting, shown in Fig. 3, was turned to fit the counterbore, the casting being held to the faceplate by two bolts, as shown in Fig. 4.




Details of Lathe Drilling Fixture.

A groove *A* was then placed in the fixture, central with the counterbore. Into this groove the pin was placed and held in position by two studs and a strap, shown in Fig. 2. Figs. 4 and 5 show the fixture assembled with the pin in position for drilling.

With this arrangement very satisfactory results were obtained. C. W. PUTNAM.

Holyoke, Mass.

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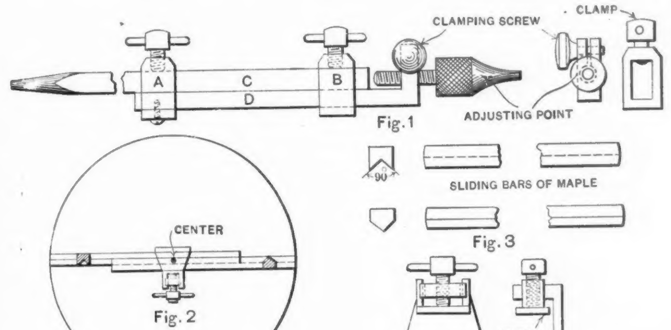
## INSIDE GAGE AND TEMPORARY CENTER.

*Editor* MACHINERY:

Being constantly in need of an inside gage for accurately transferring measurements ranging from 18 to 54 inches, I devised the arrangement here illustrated. Its advantages are that it is very cheap to make and can be very quickly set to any size within its limits.

A piece of ½-inch square cold-rolled steel is bent up at one end and then drilled and tapped to receive an adjusting point. The end is then split with a hacksaw, and fitted with a clamping screw which securely locks the adjusting point. *A* and *B*,




Details of Gage and Center.

Fig. 1, are two clamps for holding the removable rod *C*. A small screw secures clamp *A* to the end of the rod *D*, while clamp *B* is free to slide along the rod so that it can always be clamped at the end of rod *C*. Rod *C* is made of ½-inch square cold-rolled steel rounded down at the point. Several of these removable rods are provided, varying in lengths to accommodate the work at hand. The use of the gage will be apparent to any one familiar with measuring instruments. If used with ordinary care it will detect a variation of .0005 inch (½ thousandth of an inch) or less.

The simplicity and success of this method for obtaining dif-

ferent lengths, suggested the use of the same idea for another purpose—that of temporarily finding the center of a finished hole, as is so often required when laying out work.

A glance at Fig. 2 will show how the usual hunt for a stick, a saw and a wedge can be avoided when this work is to be done. Figs. 3 and 4 show the sliding bars and clamp in detail. By having on hand a number of maple bars of different lengths, the device may be applied to any size of hole. The ends are made slightly tapering from the bottom outward and if the arrangement is set just a little larger than the hole it is to fit, it will drive snugly into place and stay there. WILFRED J. THOMPSON.

Pittsburg, Pa.

* * *

## HINTS FOR PLANER WORK.

*Editor* MACHINERY:

In my shop experience I have often noticed that in using angle plates, on the milling machine or planer, the plate is usually placed with the broad side *toward* the cut. This is, no doubt, owing to the fact that the braces look as though they were designed to resist a pushing strain. It is very easy, however, to show that much better results will be obtained when the broad side is turned *from* the cut.

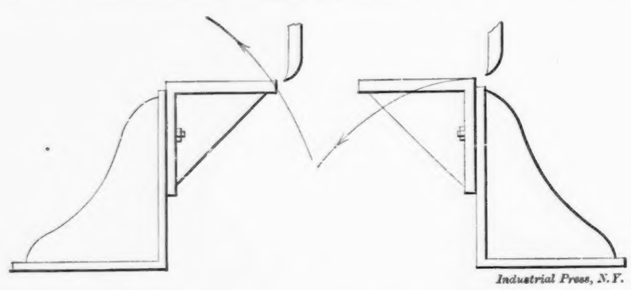



Fig. 1. Fig. 2.

Where the angle plate is placed facing toward the cut, as in Fig. 1, it will be seen that the work is going to lift up into the tool, and is not going to let go until all of the spring has been lifted out of the angle plate. This will be repeated, up and down, continually, thus giving a rough surface to the work, or, as we say, causing it to "chatter." If the cut is very heavy, the chances are that the work does not let go, but digs in so deeply that it is torn from the plate or the

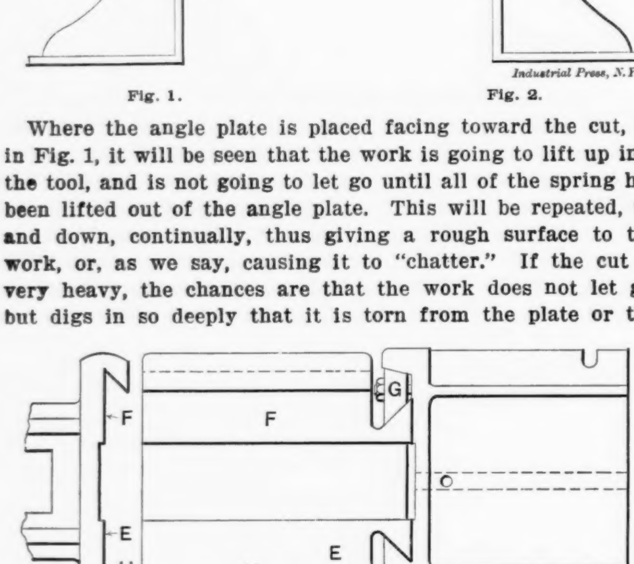



Fig. 3.

tool is broken. If, now, the angle plate is turned from the cut, as in Fig. 2, the work will spring down, away from the tool, without any digging or chattering.

I once knew two machinists, one of whom was generally quicker than the other, yet on a certain job the slow one always beat the other just through understanding this principle and facing his angle plate the right way. I think this principle will hold in all kinds of machining. Strap or hold the work so that when it springs it will be away from the cutting tool. This will avoid chattering and spoiling work.

There is no doubt that the more accurately jigs are made, the greater will be the time saved in assembling the completed parts. It is, therefore, good policy to so construct jigs that they will prove their work before it is removed.

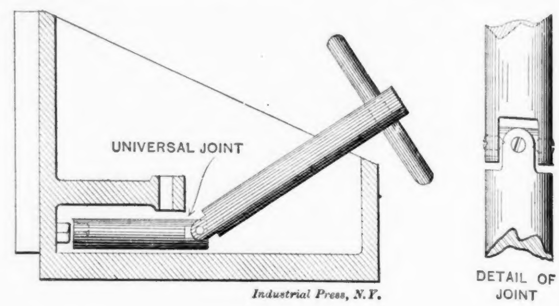



Fig. 4.

A jig, shown in Fig. 3, for planing a milling machine knee, is constructed on this principle. The jig is planed at *A* and *B*, perfectly true with the surface to which the knee is clamped by the gib *G*. It will be seen that when the knee is finished on top at *F*, *E* and *C*, and down the side *H*, the work can be tested in three directions, with a large square, in order to prove that the planing is correct before removing the knee from the jig. When testing, the square is tried down the side of the jig at *A* and *B*, then the blade of the square can be tried along the side *H*.

Any machinist who has skinned his knuckles by the slipping of a wrench will appreciate the form of wrench shown in Fig. 4. It often happens that a nut or screw is in such a place that it can hardly be reached with any form of regular wrench, owing to the lack of room in which to swing the handle. A socket wrench, as shown in the sketch, can be used with convenience in a great many such places. The universal joint allows the socket part of the wrench to be applied wherever desired, while the handle, making any angle with the shank, can be operated in any position that is convenient. H. L. CAMERON.

Cincinnati, Ohio.

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## A HURRY-UP JOB.

*Editor* MACHINERY:

Several years ago I had occasion to patch a plate for a printing press—a hurry-up job, of course. The owner of the press thought the damage to the plate quite serious, but I assured him that we could let him have it in about four hours' time.

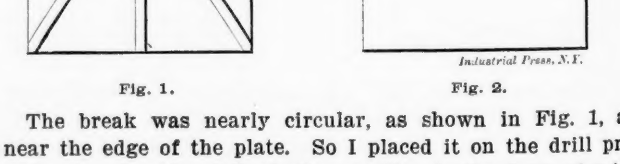
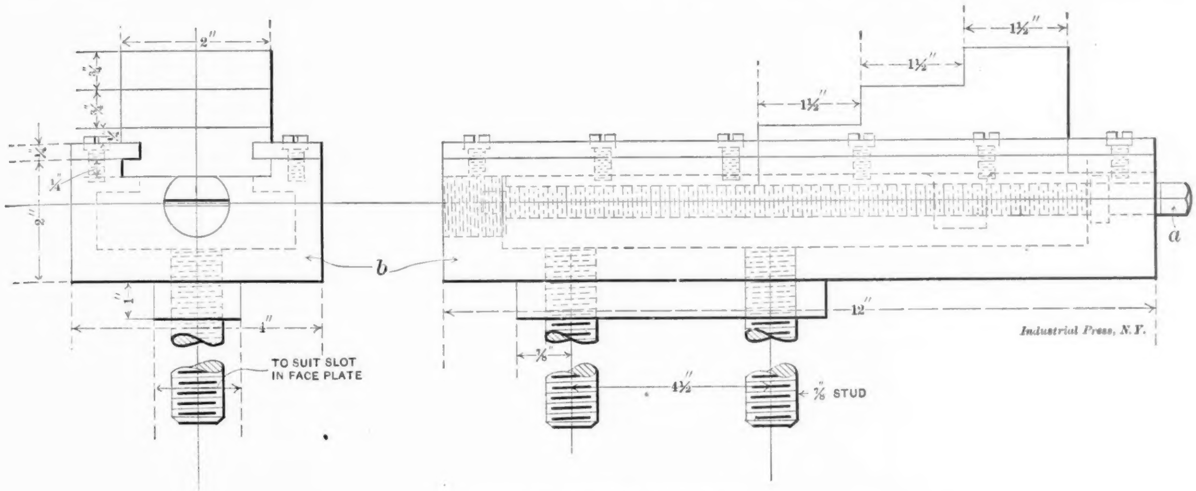



Fig. 1. Fig. 2.

The break was nearly circular, as shown in Fig. 1, and near the edge of the plate. So I placed it on the drill press and cut or bored out the broken portion in the form of a true semi-circle. This was done by means of a bar supported in the spindle of the drill press and supported at its lower end by the hole in the drill press table. The bar carried a cutter of such a radius that it would sweep through a circle of the size of the place cut out. I then clamped a flat plate of suitable size on the faceplate of the lathe and cut out a semi-circular piece of the right diameter to fit in the place cut out of the large plate. A nut and capscrew were clamped on the

ways for a stop. I then fitted the piece to the plate, clamping it down as shown, and drilled and tapped three holes in it about ¾ inch in diameter as at *b b b*, into which I screwed three plugs. Then I drilled small holes in the opposite plugs half through the plug and half through the plate, as at *c c*, into which I drove two pins. I calked the seams a little and finished the surface by filing. JOSEPH MERTEN.

Houghton, Mich.




Jaws for Clamping Face-plate.

## FACEPLATE JAWS.

*Editor* MACHINERY:

The inclosed drawing is of a faceplate jaw device, which, as will be readily seen by the sketch, is to bolt on the faceplate by means of studs. The jaw should be of tool steel. This jaw is grooved for a gib and has a nut or tap hole for the adjusting screw *a* which is provided with a shoulder, as shown, for a seat when the jaw is being tightened against the work. The tongue is made of a size to fit the slots in the faceplate. The end *b* of the jaw is drilled and pipe-tapped for a plug, which also answers as a bearing for the end of the screw. A hole of this kind also permits the screw to be entered from this end of the device. The body of the jaw is cored out in the manner shown by the dotted lines.

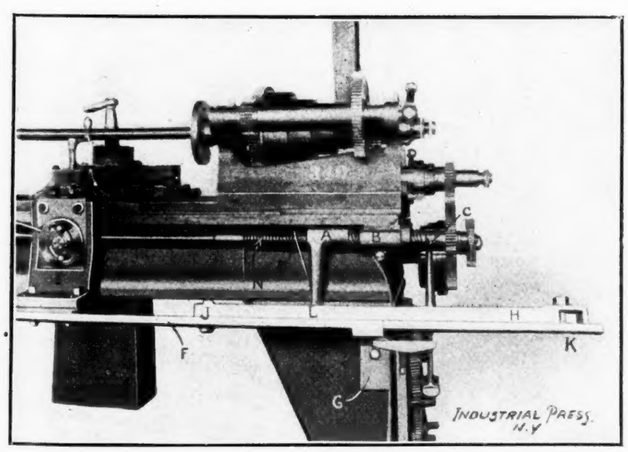
Holyoke, Mass. C. W. PUTNAM.

* * *

## HOW A TAP PROBLEM WAS SOLVED.

*Editor* MACHINERY:

Owing to the fact that the taps in our shops expanded or contracted somewhat when being hardened, it became necessary to make the pitch of these taps slightly greater or less than standard. The cut herewith shows a rig which I devised.




Attachment for Varying Pitch Cut by Lead Screw.

Sleeve *A* is a casting, on which a screw of one inch lead and four threads is cut and fitted in the nut *B*, which is fast to the lathe. The lead-screw runs in sleeve *A*, and the thrust is taken by collars *C* and *D*, the end thrust having been removed. A casting *E*, fitted to the nut plate of the lathe, carries the rod *F* in the bracket *G*. On the arm *A*, just behind the point *L*, is a hardened roll which is kept in contact with bar *H* by the spring *N*. This bar *H* is swiveled at *J* and clamped at *K* and it will be readily seen that if it is set at an angle to *F* and the carriage of the lathe is advanced, the sleeve *A* will advance or recede according to the angle.

By the use of this rig, we have a tap that is practically correct and we can also get a leadscrew with a short pitch for hob taps. I think also that with the proper filing and fitting of the bar *H*, and with the lathe set on a good foundation, a precision screw could be cut. FRED J. PERRY.

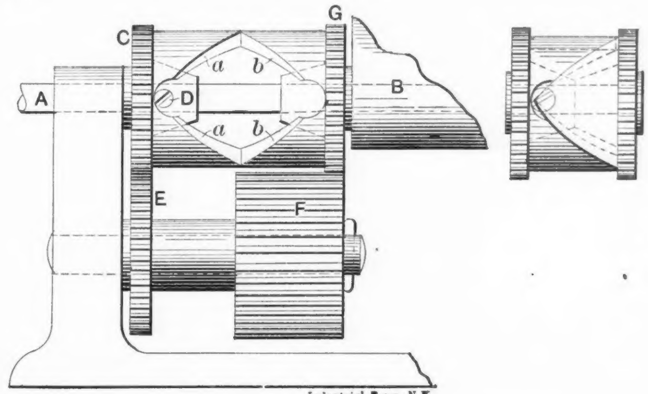
Lawrence, Mass.

* * *

## MECHANICAL MOVEMENT.

*Editor* MACHINERY:

I send a sketch of a mechanical movement which may be of interest to your readers. The requirements of this attachment were a simple, compact means of giving a slow, uniform end motion to part of a lens grinder, this motion not to have any pause at the end of oscillation, such as a crank would give.




Mechanism for giving Uniform Reciprocating Movement.

Referring to the sketch, power is applied to shaft *A*, upon which hangs the part *B* to be oscillated. *C* and *G* are two gears with abutting cam faces, *a a*, *b b*. Gear *C* being fast to shaft *A* by means of screw *D*, turns gear *E*, which is one piece with gear *F*. This turns gear *G*, which is hung loose on shaft *A*. The gears are differential and are so cut that gear *G* loses one revolution while gear *C* turns 352 times. Gear *G*, carying part *B*, is pulled continuously toward gear *C* by a spring not shown. The points of the cam surfaces will thus slip by each other and gear *G* will gradually approach gear *C* until the lobes of the cams interlock, as shown in the right-hand sketch. This is one extreme of travel, and as gear *C* will still continue to turn faster than gear *G*, the tendency will then be for the two pairs of cams to force themselves apart until the other extreme is again reached.

Shaft *A* turns 176 times for one back-and-forth movement of part *B*. A part of the base of the machine is shown.

The movement is patented by E. M. Long and is owned by the Standard Optical Co., Geneva, N. Y. M. LONG.

Geneva, N. Y.

# SHOP KINKS.

**A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP**
**Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.**

## CENTER SQUARE.

W. W. Cowles, Waterbury, Conn., sends us a sketch of a handy center square which is very simple and can be made at a small expense. A piece of sheet steel, about 3-32 inch thick,

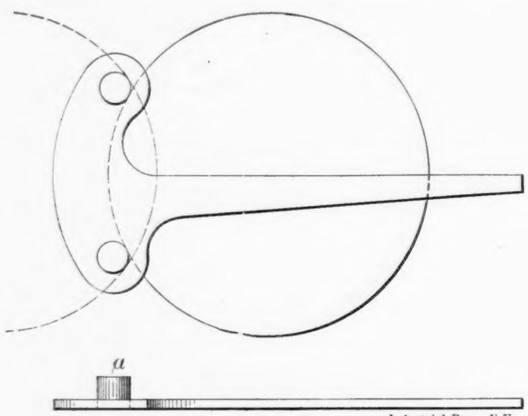



Fig. 1.

is cut out as illustrated and fitted with two pins *a*, which project below the surface and serve for guides. As will be seen this gage may be used either on the inside or outside of a circle.

## FILE HANDLE.

M. H. Perrin, Vancouver, Can., writes: The accompanying sketch shows a file handle we use for filing large surfaces. It is easily made by cutting a piece of sheet iron (about 1-16 inch thick) to the required shape and bending it so as to form an opening at *A* to receive the tang of the file. The front,

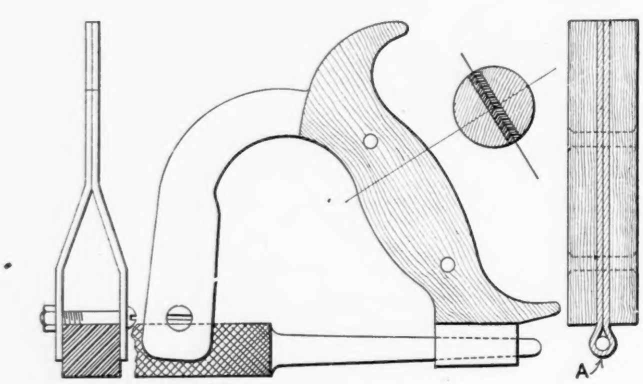



Fig. 2.

or clamp end, can be bent to fit any style of file, the file being held by a screw and nut, as shown in the sketch. The handle is finished by riveting two pieces of wood on the sides and shaping them to fit the hand.

## DRILL PRESS ATTACHMENT.

E. J. B. sends a drawing and description of an attachment for the drill press for drilling holes in the sides of cored holes in castings. The cored holes were so small that there was no room to swing a ratchet, being only 2 by 4¼ inches. The attachment consists of three gears, rough cast, arranged in mesh between the two wrought iron plates *A* and *B*, as shown in Fig. 3. These iron plates, which are each 5½ by 1 7-16 by ¼ inches, are held the proper distance apart by the bushings *L* surrounding each of the machine screws *J* and the pin *K*, each end of which is bolted to one of the plates. The gear *C*, the driving gear, is driven by the shank *F*, which fits into the drill press socket. The shank, *F*, has a keyway cut in at *S*, which engages with the feather set permanently in the gear at *O*, so that the attachment may be raised and lowered as far as the keyway will allow without interruption of motion, in

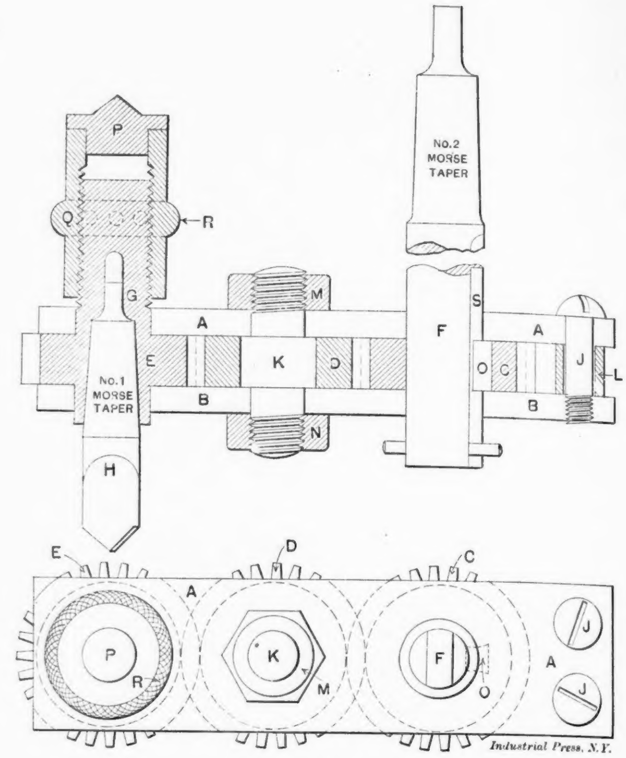



Fig. 3.

addition to the drill feed. The driving gear drives the idle gear *D*, which revolves on the pin *K*, and drives the gear *E*. This gear *E* drives the drill spindle *G*, and thus the drill *H* is driven right-handed. To give the drill pressure there is a feed sleeve at *Q*, which is fed by holding the knurled head *R*. The drill *H* is made from an old drill shank flattened out up close to the taper.

## SLOTTER TOOL HOLDER.

Fred Harrison, Philadelphia, Pa., sends a sketch of a spring tool holder which he has used very successfully for roughing work on the slotter. The tool is held by two setscrews in the head of the holder, while the head itself is held in the shank of the holder by a forked joint and pin. The back sides of

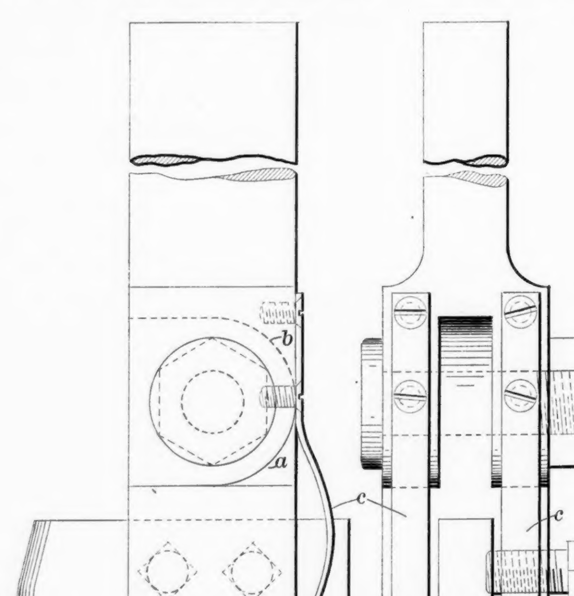



Fig. 4.

the fork are rounded off at *a* and the back side of the tongue on the head is rounded off at *b*. This allows the head, with the tool, to spring back on the return stroke. At the end of the return stroke the springs *c c* return the tool to working position.

### METHOD OF TURNING BALLS.

G. Lind, Chicago, sends a scheme for turning steel balls. He says: We had a job requiring a steel ball 3 inches in diameter. After roughing it out we first tried to finish it with the tool shown at *b*, but without any kind of success. Then I tried the following method: I set the pivot of the compound rest exactly under the center of the ball, locked

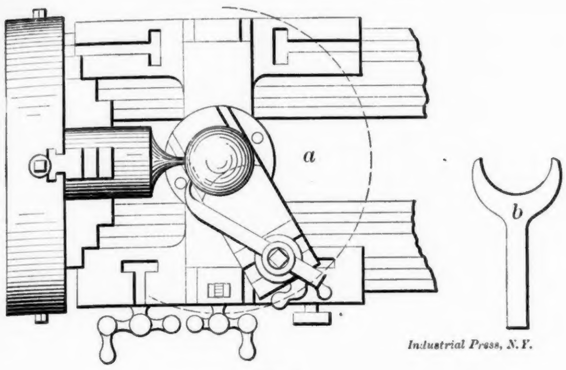



Fig. 5.

the carriage and cross-feed and loosened up the nuts of the compound rest. For turning I used a round-pointed tool, as shown at *a*. In this position it is evident that I could feed the tool in a semi-circle around the ball by swinging the compound rest on its pivot. In this way I was able to finish the ball perfectly round in very short order.

### INSIDE AND OUTSIDE ADJUSTABLE GAGES.

Geo. M. Woodbury, Toledo, O., sends sketches of an inside and an outside adjustable gage for accurate work in laying out drill jigs, and in setting tools on lathes, shapers, planers and milling machines. The outside gage is shown in the side view and in the sectional end view marked Y in Fig 6. At X in the same figure is a sectional end view showing how the gage is constructed for inside work. The top and bottom edges are rounded so that the diameters of holes may be easily measured.

The gage consists of a stepped block, *B*, mounted so as to slide upon the inclined edge of the block *C*. There are V-ways upon the upper edge of the latter and the block *B* is split and arranged to clamp over the ways by the screw shown at *S*. All parts of the gage are hardened and the faces of the steps, marked *A*, are ground and finished so that at any position of the slide they are parallel to the base of the block *C*. The lower split portion of the block is spring-tempered to prevent breaking under the action of the screw and also to cause it to spring open when loosened. The gage has the advantage that it can be quickly adjusted to any size within its limits, which does away with using blocks. In planing a piece to a given thickness, the gage

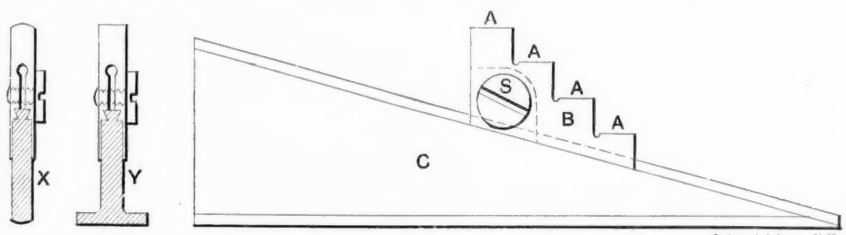



Fig. 6.

may be set to that height with great accuracy by means of a micrometer caliper and then the planer or shaper tool adjusted down to the gage. This method does away with the "cut and try" process and will bring the finishing cut within .001 inch of the required size. If the piece being planed, or the opening to be measured, is larger than the extreme limit of the gage, parallels may be used. In fitting bushings into bushing holes, the adjustable gage may be moved out to fit the hole and then, when the bushing is finished to the diameter given by the gage, as determined by a micrometer caliper, a driving fit is ensured.

### PRACTICAL HINTS.

"Progress" sends several kinks, the first of which is a method for expanding the babbitt in a box where it was found to be so loose after babitting that the bearing could not be bored.

First, the box was chucked in the lathe, then a piece of cold-rolled shafting, *A A A*, Fig. 7, was placed in the tool-post parallel with the ways. A collar *B*, slightly smaller in diameter than the babbitt, was slipped over shaft *A* and brought up tight against the babbitt by moving the cross slide of the carriage. Then with the carriage clamped, the

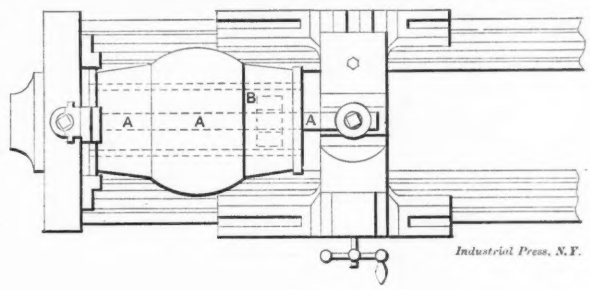



Fig. 7

lathe was started up backwards at a slow speed, causing the collar to travel in a spiral to the opposite end of the box, when the carriage was reversed and the collar made to travel back to the starting point. This operation was repeated several times, and as now the babbitt was found to be very solid and tight, it was bored to size, and this made a very satisfactory job.

A quick method of truing up a pulley to be rebored in the lathe is to push into it a mandrel tight enough to prevent any

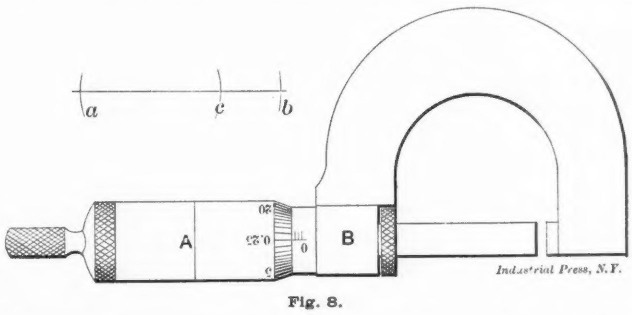



Fig. 8.

shake and then to true up by means of the projecting end of the mandrel. If one desire to ascertain the correctness of this method, the mandrel can be taken out and the hole will be found to run true.

To set dividers accurately, I take a 1-inch micrometer and cut a line entirely around the thimble as at *A*, Fig 8, and then with the instrument set at zero I make a punch mark *B* exactly one inch from the line on the thimble. If less than one inch is wanted, open out the micrometers and set the dividers to the dot and line that give one inch more than the distance wanted. Now with the dividers make two marks across a line, as at *a* and *b*, Fig. 8, and then set the dividers to one inch and mark another line as at *c*. The distance from *c* to *b* is the amount desired, and the dividers can be set to it.

Where a number of pieces are to be turned taper and be just alike, it is well to set the tool high, to produce better work and to save the tool. The tool having been set and the proper taper found, a scratch made on the tail spindle with the point of the tool will be found very convenient for setting the tool the next time.

For making a small number of sheet metal punchings, a case-hardened, wrought-iron or machine steel die is serviceable.

When a mandrel or plug of any kind gets stuck in a hole, it will quickly loosen if gasoline can be got into the place.

I have heard, but never tried it, that a cracked bell can be restored to good tone by running a hacksaw through the crack so as to separate the edges far enough to prevent them from striking together. We recently got a job of cutting down a new bell that was too large in diameter to swing between the brackets. We remedied this by placing the small end in the lathe chuck and putting in a cast-iron plate to support the large end on the tail center.

## NEW TOOLS OF THE MONTH.

**Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.**

### PIPE WRENCH.

A neat pipe wrench, shown in Fig. 1, is manufactured by the Frank Mossberg Co., Attleboro, Mass. It is 6 inches long and weighs but eight ounces, yet will take any size pipe or bolt from ⅛ to ¾ inch in diameter. The cut shows the principle of the wrench so clearly that a description is scarcely necessary. In pulling on the wrench the jaws tend to crowd together and grip the pipe and hold it firmly, and in reversing the motion the wrench releases itself. The jaws and handle are drop forgings handsomely polished. The design is extremely simple for an adjusable wrench, consisting of but three parts—the two drop forgings and the pin.


Fig. 1. Pipe Wrench.

### BEVEL PROTRACTOR.

The Athol Machine Co., Athol, Mass., have just brought out a new bevel protractor, shown in the cut, Fig. 2. The blade swings 90 degrees between the frame plates and is held in position by a thumb nut and a screw operating upon a hooked coupler in the indicating arm. The protractor is made of thin tool steel so that when no square edge is available lines can be accurately taken from a drawing and transferred to the work by the use of this tool. It is a very handy tool for draftsmen, and is made in two sizes, 9 and 12 inches, with one or two blades, as desired.

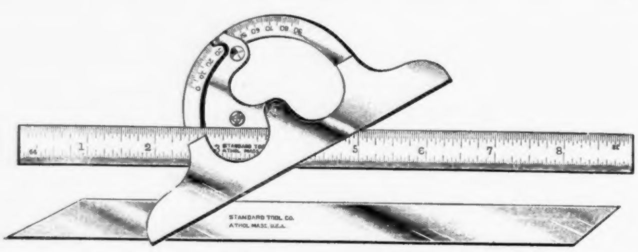


Fig. 2. Protractor.

### MACHINISTS' VISE.

A small vise for toolmakers' and machinists' use has been brought out by the Hopkinson Machine Works, 23 Taylor St., Springfield, Mass. The jaws are 2½ inches wide, one inch deep and open 2½ inches. The entire length is 6 inches and the weight, 4½ pounds. The vise is thus light enough to be used on the sensitive drill press or the speed lathe and it is strong enough to hold work without slipping. The movable jaw is clamped to the T-slot in the base by means of a bolt and is adjusted by a screw in the follower plate. The follower is held by two pins fitting into holes in the base and can be quickly set in the desired position.

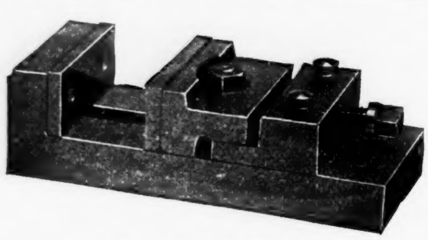


Fig. 3. Small Vise.

### BENCH TAPPING MACHINE.

Mr. H. A. Tuttle, Stamford, Conn., has recently patented and is manufacturing a new bench tapping machine, known as No. 1 A, designed especially for rapid, accurate work. The capacity ranges from a No. 2 to a No. 14 tap. It has a swing table with a range of adjustment of 4 inches, which adjustment can be increased by lengthening the column. The work is held in position on the table, the tap being operated to and from the work at will either by means of a foot lever or a hand lever. The machine can be set to tap only to the required depth, which prevents breaking taps in blind holes.

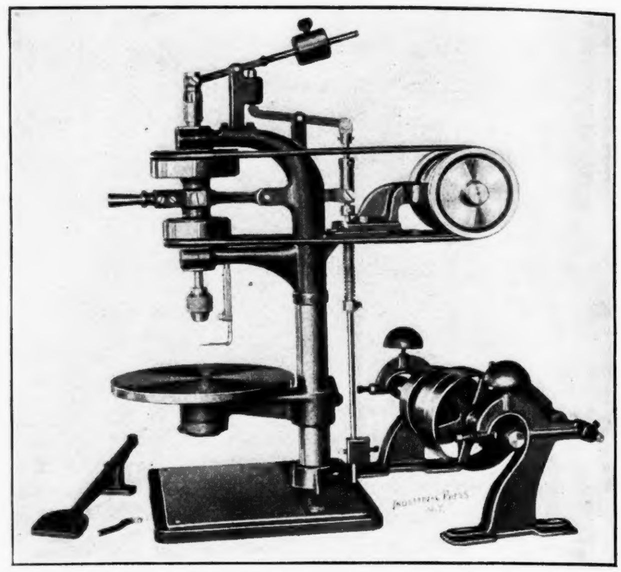


Fig. 4. Bench Tapping Machine.

The machine has an adjustable stripper to prevent work being raised from the table, and its base is finished, giving greater range for jig work. The tap spindle is driven by an endless belt from a shaft having a two-speed cone on the rear of the machine, the belt running over an idler in line with the cone pulley at the rear to give the opposite motions to the friction pulleys. The weight counterbalances the chuck and chuck spindle, which has a free movement through a hollow spindle driven by the friction pulleys. The reverse pulley is small and releases the tap rapidly. The weight lever, being raised by a compression spring plunger at the rear of the bracket, starts the tap and prevents stripping of the thread in the work. This spring may be so light that the tap will not destroy the finest thread, or the tension can be increased, as required, by a larger tap.

### LATHE PAN.

The Amstutz-Osborn Co., Caxton Building, Cleveland, O., have designed and placed on the market an adjustable lathe pan of which an engraving is shown in Fig. 5. The pan is entirely of metal and hence is fireproof, and is so designed that the brass and iron chips may be kept separate. The framework may be adjusted to bring the pans at any point between 20 and 28 inches from the floor and it is built in

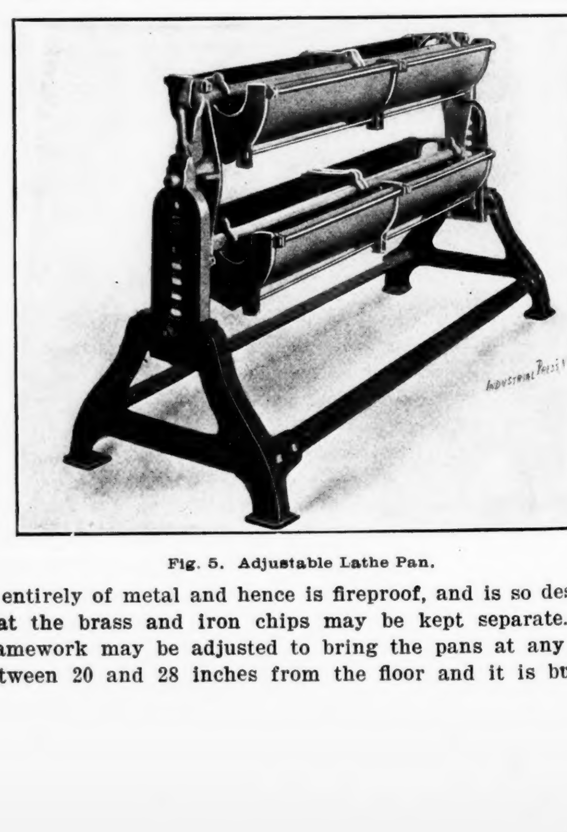


Fig. 5. Adjustable Lathe Pan.

any length desired. There are swinging arms supported at their centers at each end of the frame and the two sets of lathe pans shown in the engraving are carried at the extreme ends of these arms. By reversing the position of the arms the pans which are uppermost may be lowered and those which are below in the engraving may be raised in position to catch the chips from the lathe. This change is made by throwing down a handle at the end of the frame, swinging the arms through 180 degrees and replacing the handle. In emptying the pans it is not necessary to remove the fixture from under the lathe; the emptying is done by swinging the arms through 90 degrees, which places the pans where they are easily accessible and can be removed and emptied, no shovel being required as with the old-style wood chip box.

## IMPROVEMENTS IN DIE STOCKS.

In Fig. 6 is shown an illustration of a new ratchet die stock for threading and cutting pipe, manufactured by the Hart Mfg. Co., Cleveland, O. It is fitted with adjustable quick-opening dies and has a leader screw which is of assistance when working in close quarters. The ratchet is reversible, making it suitable for either right or left-hand threads, and all parts are enclosed to protect them. Either one of the two handles can be used to operate the tool and it cuts threads with greater ease than an ordinary tool because the power can be applied to better advantage. It is made for threading pipe in sizes of from one to four inches. A number of improvements have also been made in their regular pattern die stocks, one of which is the gage for setting dies to size. Another improvement is in the cutting-off tool, which is fitted closely into an adjustable guide box, and when the block is clamped by a lock plate the cutter is firmly held, thus insuring smooth cutting.

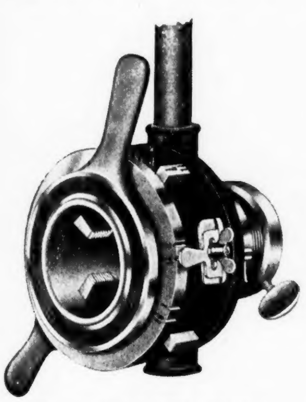


Fig. 6. Ratchet Die Stock.

The Hart Mfg. Co. are placing on the market what is virtually an entirely new line of die stocks for threading bolts and rods. Among the advantages are the ability to thread much closer to a shoulder than formerly, the means of setting the dies more accurately and the employment of a positive stop gage for cutting delicate threads. This gage is made to slide on the periphery of the stock and regulates the motion of a cam which controls the chaser dies. It will be understood that the dies are quick-opening, rendering it unnecessary to turn them back over the thread after the thread has been cut. They are put up in neat cases in machinists' sets, in a large number of combinations to suit different requirements.

## A NEW GRADUATING MACHINE.

The illustration, Fig. 7, shows a new graduating machine, the product of the R. K. Le Blond Machine Tool Co., of Cincinnati, O. The machine was originally designed for use in the Le Blond shops for graduating compound rest swivels, milling machine saddles, dividing heads, index collars, taper attachment guide bars, etc., and was found to produce work so rapidly and accurately that it has been placed upon the market.

The spacing and length of stroke for long and short lines is automatic. It will graduate at any angle from the vertical to the horizontal through the entire 90 degrees. It is capable of graduating all work from 2 inches to 40 inches in diameter.

The tool holder is on a sliding piece that can be adjusted for different thicknesses of work, and is arranged with a foot or depth gage which will follow any inequality of the work, making a line the same depth on work which is not perfectly true. At the same time the divisions will be perfectly accurate.

The work spindle has a hole through its entire length and is bored to fit Morse taper No. 3. The nose is also threaded so that work can be held either by a taper plug or in a chuck at the option of the operator. The spacing is accomplished through a worm and wormwheel. A ratchet actuated by means of a rack, shown in a diagonal position in the engraving, is geared to the worm and governs the angular movement of the worm for each stroke. Enough movement can be had to make one revolution or to take one tooth of a 150 tooth ratchet wheel. By disengaging the pawl the ratchet wheel may be turned by hand, thus rotating the work to any position desired. Three ratchets are furnished, which cover the entire field for circular graduating. A large number of graduations can be obtained with these wheels, but those generally in use are 100, 125, 200, 360, 1208. This last number is for 1-16 inch taper per foot.

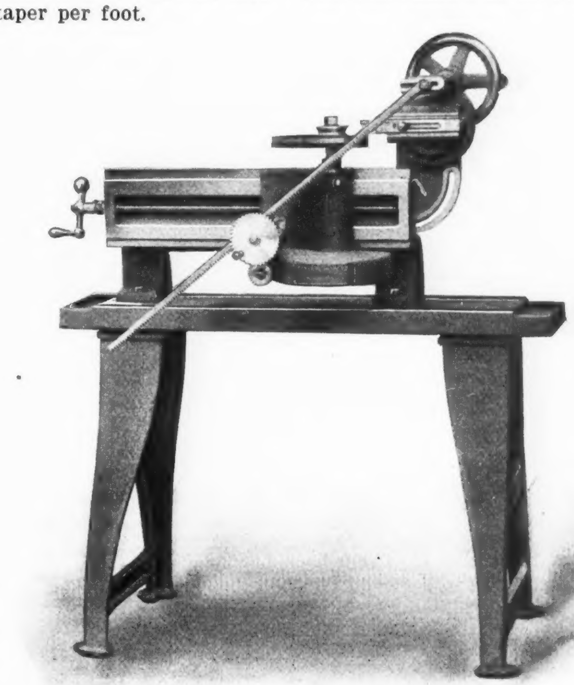


Fig. 7. Le Blond Graduating Machine.

The graduating lines can be made long and short for measurements not divisible by five. With a cam of four projections the graduations can be made similar to eighths, and with a cam of eight points, similar to sixteenths, on a foot rule.

Most circular work is graduated with a cam of five divisions, making four short lines and one long line. This gives divisions of fives, and, when numbered for every ten, makes a nice appearance and is the one familiar to all mechanics indicating degrees and thousandths of an inch.

The slide holding the tool holder is operated by a cam against which it is kept by a spiral spring. The cam is fastened to a large gear, which is turned by a pinion on the hand-wheel shaft. This pinion is regulated in size so as to turn the same number of revolutions as there are points on the cam. The hand-wheel shaft also carries the crank for moving the ratchet wheel. The work carrying slide can be adjusted to any position by the screw, so that work of all diameters can be brought to the cutting tool. The actual depth of cut is regulated by a knurled depth screw on the tool head.

## CHAIN HAMMER.

The Turner, Vaughn & Taylor Co., Cuyahoga Falls, O., have brought out a chain hammer having several novel features, adapting it to welding chain links rapidly and uniformly. In the operation of chain welding it is necessary to first strike a heavy blow to force the weld together and then to strike a few light blows to shape the link and complete the weld. In hammers for this purpose it is customary to return the hammer bar to its original position by means of a spring which tends to retard the hammer blow. In the new hammer this fault has been overcome by connecting the spring to a toggle joint in such a way that its effect is the greatest when the head is in its upper position. As the hammer descends the effect of the spring becomes less. The light shaping blows are accomplished by means of a supplementary spring which can be made to act to cushion the hammer when it has nearly reached its lowest position, with the result that the light shaping blows can be very readily struck. The improvements in

this hammer enable it to produce work much more rapidly than formerly. It is made in six sizes for chains of 3-16 to ½-inch stock.

### ELECTRICALLY DRIVEN SHAPER.

The engraving, Fig. 8, shows a heavy traveling head shaper with two heads, as built by the Cincinnati Shaper Co., Cincinnati, O., when it is to be motor driven. It is an 18-inch by 12-foot shaper and two direct-geared variable speed motors are employed, one for each head. The motors are not in place, but the brackets for supporting the motor, the gear guards and the large gear, which is driven by the small pinion on the motor, are shown for driving the right-hand end of the machine.

The machine is unusually massive, and a bearing strip is placed on the lower edge of the bed for the table aprons, giving a strong support. The automatic feeds, both for the saddle and circular attachment, are of recently patented construction, and the direction of feed can be easily changed while the machine is in motion. The machine is well adapted for a class of work that cannot be done on the ordinary type of shaper, particularly for work of the heaviest class. A machine like that in the engraving is now in operation at the plant of the W. R. Trigg Co., Richmond, Va.

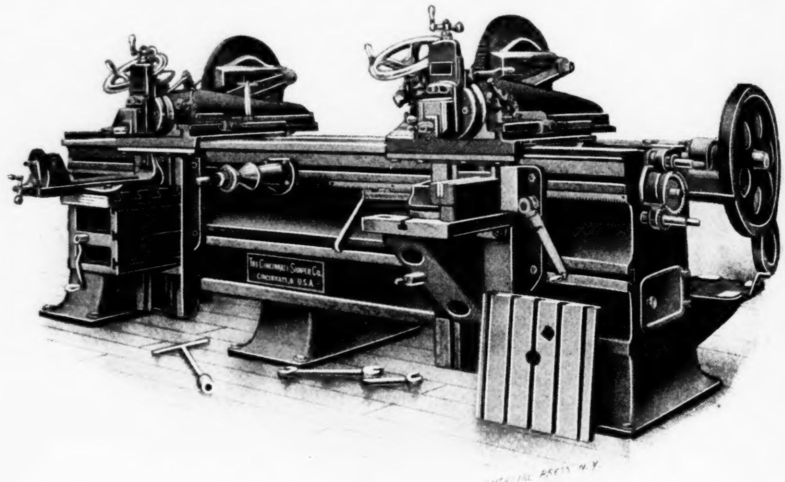


Fig. 8. Heavy Traveling Head Shaper.

### NEW RADIAL DRILL.

In Fig. 9 is an illustration of a new 4-foot radial drill manufactured by the Fosdick & Holloway Machine Tool Co., Cincinnati, O. The drill has convenient arrangements for tapping, positive geared feed, and back gears on the head, bringing the greatest amount of power possible directly to the work. The reversing or tapping device is so arranged that the spindle may be started in either direction without shock or jar. The tapping lever which controls this device travels with the head and is thus always where the operator can have complete control of his machine without leaving his position. The feeds are arranged in geometrical progression.

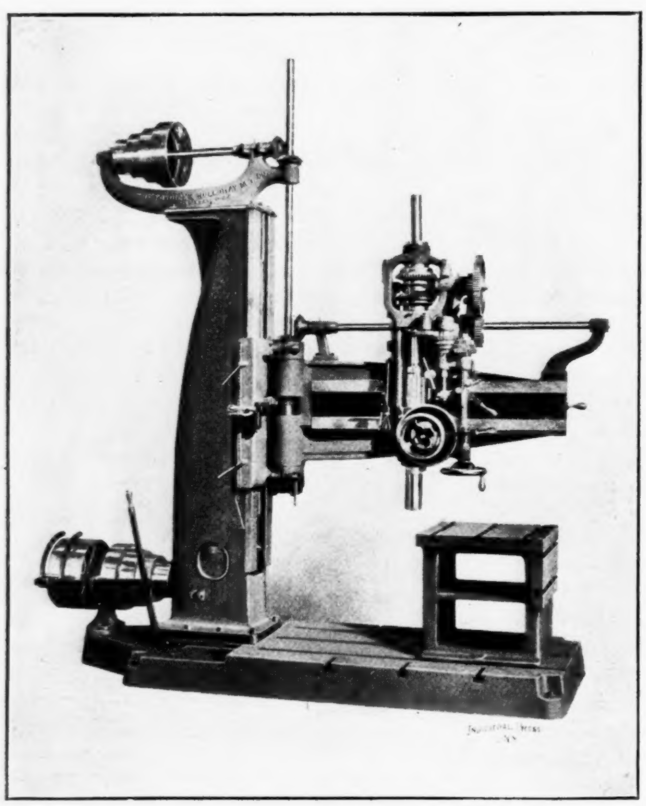


Fig. 9. Four-foot Radial Drill.

The base is deep and has no projection, making it suitable to have the top of the base level with the floor. The column is of box section and the radial arm is exceptionally stiff, having stiffening ribs both on the upper and under side. It is supported on ball thrust bearings. The arrangement of the wheels and levers is compact, the saddle is raised and lowered by power and has a long bearing on the column. No countershaft is employed and the machine can be placed with or at right angles to the main shaft, as desired. The bevel and miter gears have planed teeth.

The machine drills to a center of a 96-inch circle; greatest distance from spindle to base, 54 inches; diameter of spindle 1 13-16 inches; traverse of spindle, 14 inches; traverse of saddle, 39; traverse of head on arm, 32 inches; width of belt on cone, 3 inches.

### COMBINED SURFACE AND DRILL GRINDER.

The accompanying illustration, Fig. 10, shows a machine intended for both surface and drill grinding. With this machine both sides may be used simultaneously. The grinder is simple in its operation; no adjustments are required to grind drills of different sizes.

The wheel for surface grinding is 12 inches in diameter by 1½-inch face, and is central over a table 10 inches wide by 18 inches in length, which can be lowered to 20 inches below the spindle, so that there is a space of 14 inches under the wheel. This drop can be secured without boring a hole in the floor for the elevating screw. The screw is geared to the handwheel shaft through a pair of accurately cut miter gears, and a dial graduated to the thousandths insures the making and reading of fine adjustments. The table is gibbed to the slide on the column and the oil holes leading to the bearings of the handwheel shaft and thrust bearing of the elevating screw are protected from grit. When desired, one side of the machine can be equipped for plain tool grinding instead of drill grinding, and can be provided with a suitable rest at the wheel.

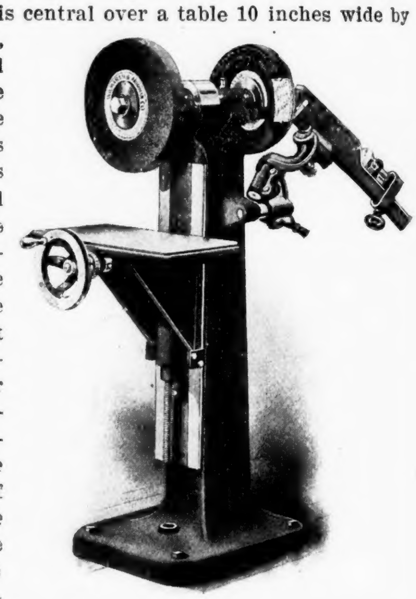


Fig. 10. Wilmarth & Morman Grinder.

### MOTOR-DRIVEN SURFACE GRINDER

A full automatic motor-driven surface grinder, made by O. S. Walker and Co., Worcester, Mass., is shown in Fig. 11. This is the latest of the line of surface grinders built by this company, the others being belt driven, but fitted with the Walker magnetic chuck.

In this machine the magnetic chuck is built in the platen and arranged so that it is automatically magnetized or de-

magnetized as the machine is started or stopped with no switches to turn and no screws to tighten. The operator has only to lay the work on the platen and start the machine.

The grinding spindle has a motor coupled directly to its rear end, is ring oiled and the whole has micrometer vertical adjustment and quick adjustment as well. The carriage and platen are operated by a motor in the base of the machine and all the feeds are automatic at each end of the stroke. The machine has automatic dead stop, operated by means of an electrical contact when the cut is finished.

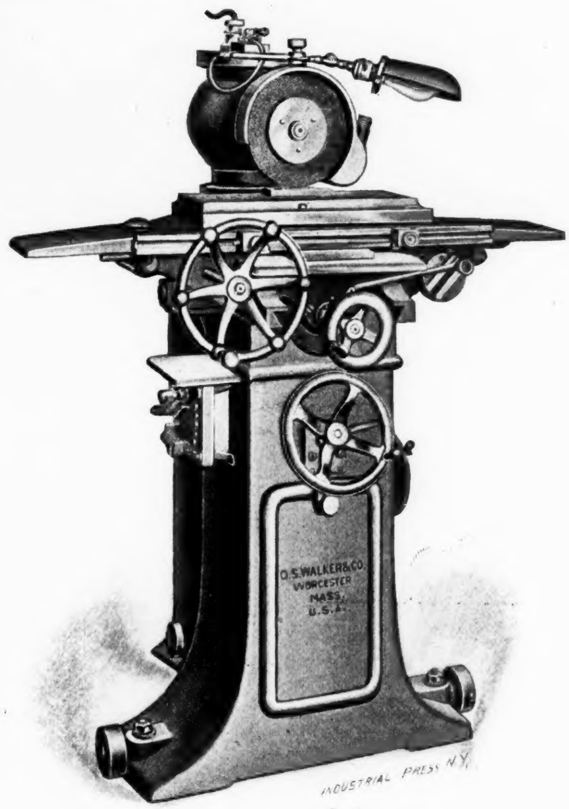



Fig. 12. Walker Electrically-driven Grinder.

The platen has variable speed and can be changed from full automatic to automatic longitudinal feed without cross feed, or to simple hand feed. The whole machine will automatically stop if the electric power fails for any reason, the switch automatically opening so that no harm can come to the motors should the current be suddenly turned on again in the line, or should the machine stop in the midst of a cut at the end of the day. One of the most interesting features of the machine is that it is portable. The machine is on three wheels (one of them a castor) and may be readily moved from place to place in the shop where most convenient. In this manner the machine may be transported all over a large machine plant and be used on the various jobs of assembling, etc., or in the tool room.

The only exterior connection to the machine is by means of a single motor cord. The machine at present is only furnished for a direct-current circuit of 110 volts, the ordinary shop lighting current. The No. 1 machine will surface a piece of work 15 inches x 5½ inches, and with it is furnished a vertically adjustable back rest (not shown). The No. 2 machine will surface a piece of work 19 inches by 6 inches and each machine will grind its own platen.

### In General.

The Boston Gear Works, 162 Purchase St., Boston, Mass., have begun the manufacture of milling cutters both for cutting the teeth of gear wheels and for general milling. They are also prepared to furnish hobs for worm gears, cutters for spiral gears, worms and for any special work. As this firm have long made a specialty of gear cutting, they have much experience in the use of cutters and in the manufacture of special cutters for their own use, and in placing them upon the market are able to utilize the results of their experience.

The Fox Machine Co., Grand Rapids, Mich., have brought out a larger size of their hand and power feed milling machine. The smaller size was brought out about two years ago and was illustrated in MACHINERY at that time. This machine has a hand rack and screw and a power screw feed, thus combining the advantages of a light power milling machine with those of a substantial hand machine. The new size has a longitudinal movement of the table of 24 inches; a transverse movement of 6 inches and vertical adjustment of 14½ inches. The spindle boxes are universally adjustable and the power feed, spindle, etc., are the same as in the smaller machine.

* * *

## STANDARD PIPE UNIONS..

### A. S. M. E. COMMITTEE REPORT ON STANDARD PIPE UNIONS.

The American Society of Mechanical Engineers some two years ago appointed a committee of five members, consisting of Messrs. E. M. Herr, A. S. Vogt, W. J. Baldwin, G. M. Bond and Stanley G. Flagg, to consider the subject of standardizing pipe unions. The work was taken up in conjunction with committees appointed by the American Railway Master Mechanics' and Master Car Builders' Associations for the same purpose, and it was agreed that the A. S. M. E. committee should proceed with the work independent of the other committees who had under consideration the subjects of uniform pipe threads and square heads for bolts.

A careful examination of the dimensions of the threads in unions made by each of the principal manufacturers of such pipe fittings showed that there were absolutely no two alike, and, further, that the other dimensions were so seriously affected by the dimensions of the thread in the coupling nut that any successful attempt at uniformity in the threads must necessarily carry with it uniformity in many other dimensions of the union itself so that the committee would be obliged to take up not only the dimensions of the threads, but also those of the entire coupling union.

A careful study of the design of all makes of pipe unions now commonly used was then made for all sizes of pipe from ⅛ to 4 inches, inclusive. The investigation showed that no make of unions was sufficiently free from defects when critically examined in all the sizes to warrant its adoption as a standard, even if it had been considered advisable to do so. The committee then decided to undertake the complete design of commercial sizes of malleable pipe unions for wrought iron pipe from ⅛ to 4 inches, inclusive, in order to get a design which they could indorse as consistent and desirable as a proposed standard pipe union.

The accompanying cuts, Figs. 1, 2, 3, and 4 show the component parts of a ¾ union with the various dimensions numbered for reference in table of sizes. The table gives the dimensions of all sizes of unions from ⅛ to 4 inches, the figures at the top referring to the corresponding dimensions in the cuts of the ¾-inch union.

It will be noted that all sizes from ½ to 4 inches have the pipe and swivel ends paneled where the pipe wrench engages. This paneling is not put upon the smaller sizes on account of the increase in size of the nut and dependent parts, necessitated by putting the ribs on the ends, nor is it considered at all necessary on these sizes.

The mark "S" on the side of the union nut is suggested for a designating mark to show that a union bearing such a mark is of the proposed standard. Such a mark could be secured by copyright by the A. S. M. E. if it was deemed wise to pursue such a course. The committee recommended that this be done and all standard unions be thus designated.

A number of ½ and 2-inch unions were made to the proposed standard dimensions and tested to destruction in two ways:

1. *Tensile Test.*—A round bar of iron, threaded with proper size pipe thread, was screwed into each of the unions, and a tensile strain was put upon it until rupture occurred. Where the casting was good the breakage generally occurred from the sharp corner under the collar on the nut, or under the collar on swivel, indicating that the uniformity in strength aimed at in the design was probably affected by the sharp corner left by finishing the bottom of the nut and the collar

on swivel end. The strength seems ample, however, so no change in the dimensions is recommended. The average breaking stress of eight pieces, ½ inch, was 11,200 pounds, minimum 9,850, maximum 12,080; of 2-inch, the average was 34,450 pounds, minimum 28,800, maximum 38,600.

2. *Transverse Tests.*—Made by screwing a round bar of iron, threaded as before, into each end of union nut, these

Bursting tests were also made with ½ and 2-inch unions by putting a pressure of water upon the union when fitted to piping. The pressure was gradually increased to 1,200 pounds per square inch, the maximum obtainable, with no failure except some leakage under these pressures at the joint.

In order to secure and maintain the uniformity aimed at, if the report of this committee be adopted, it will be necessary

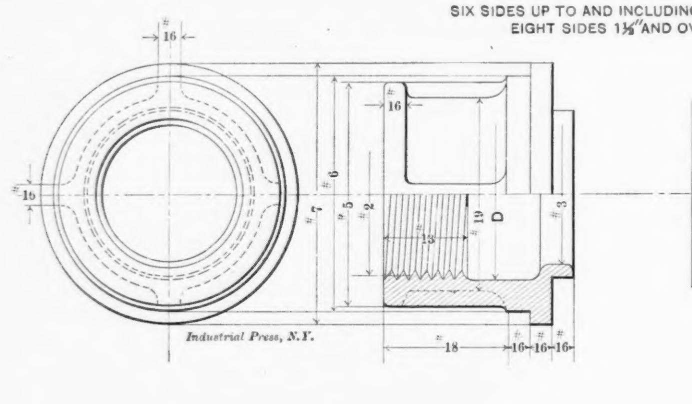



Fig 1.

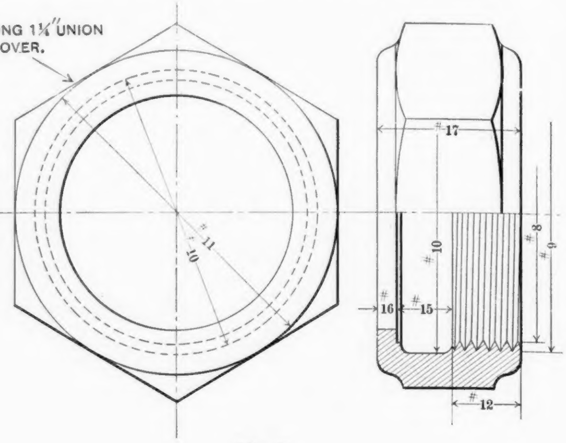



Fig. 2.

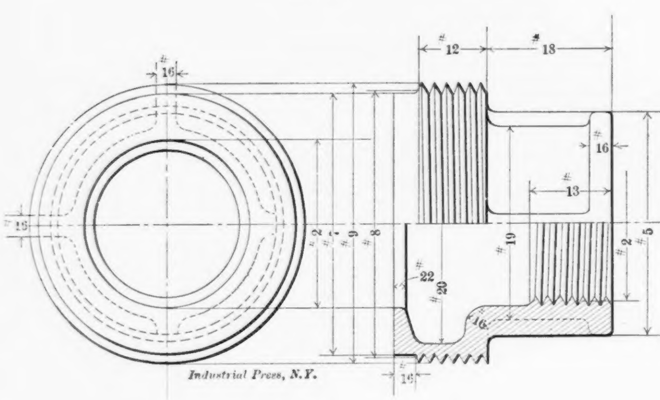



Fig. 3.

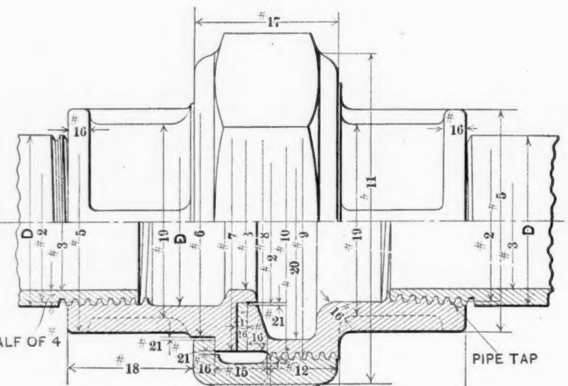



Fig 4.

**Dimensions for Proposed Standard Pipe Unions.**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | | | | | | | | | | | | | | | | | | | |
| ⅛ | .375 | .270 | .105 | .59 | .63 | .78 | .80 | .85 | .89 | 1.05 | 1.26 | ¼ | 27 | .2225 | .08 | .5625 | ½ | .59 | .615 | .006 | .05 |
| ¼ | .496 | .364 | .132 | .76 | .80 | 96 | .98 | 1.05 | 1.09 | 1.29 | .33 | 5/16 | 18 | .2625 | .10 | .6925 | 9/16 | .76 | .76 | .006 | .06 |
| ⅜ | .630 | .494 | .136 | .90 | .95 | 1.11 | 1.13 | 1.20 | 1.24 | 1.45 | .34 | ⅜ | 18 | 2825 | .11 | .7325 | ⅝ | .90 | .905 | .006 | .07 |
| ½ | .783 | .623 | .160 | 1.16 | 1.21 | 1.38 | 1.40 | 1.49 | 1.54 | 1.78 | .40 | 7/16 | 14 | .3025 | .12 | .8225 | 11/16 | 1.03 | 1.20 | .006 | .08 |
| ¾ | .992 | .824 | .168 | 1.38 | 1.43 | 1.61 | 1 63 | 1.72 | 1.77 | 2.02 | .42 | ½ | 14 | .3235 | .13 | .8725 | ¾ | 1.24 | 1.43 | .007 | .09 |
| 1 | 1.246 | 1.048 | .198 | 1.74 | 1.79 | 1.98 | 2.01 | 2.13 | 2.19 | 2.49 | .49 | 9/16 | 11 | .3625 | .15 | .0025 | 13/16 | 1.565 | 1.76 | .007 | .10 |
| 1¼ | 1.592 | 1.380 | .212 | 2.12 | 2.18 | 2.37 | 2.40 | 2.52 | 2.58 | 2.90 | .53 | .6 | 11 | .3825 | 16 | 1.0725 | .9 | 1.91 | 2.15 | .007 | .11 |
| 1½ | 1 831 | 1.610 | .221 | 2.40 | 2.46 | 2.66 | 2.69 | 2.81 | 2.87 | 3.20 | .55 | .7 | 11 | .4025 | .17 | 1.1225 | 1.0 | 2.18 | 2.40 | .007 | .13 |
| 2 | 2.306 | 2.067 | .239 | 2.89 | 2.95 | 3.16 | 3.19 | 3.31 | 3.38 | 3.74 | .60 | .8 | 11 | .4225 | .18 | 1.2025 | 1.1 | 2.66 | 2.90 | .008 | .14 |
| 2½ | 2.775 | 2.468 | .307 | 3.39 | 3.45 | 3.67 | 3.70 | 3.86 | 3.93 | 4.39 | .77 | .9 | 8 | .5225 | .23 | 1.5225 | 1.2 | 3.16 | 3.41 | .008 | .16 |
| 3 | 3.401 | 3.067 | .334 | 4.07 | 4.13 | 4.36 | 4.40 | 4.56 | 4.63 | 5.13 | .84 | 1.0 | 8 | .5625 | .25 | 1.6525 | 1.3 | 3.81 | 4.08 | .008 | .18 |
| 3½ | 3.901 | 3.548 | .353 | 4.61 | 4.68 | 4.91 | 4.95 | 5.11 | 5.19 | 5.72 | .88 | 1.1 | 8 | .6025 | .27 | 1.7525 | 1.4 | 4.31 | 4.63 | .008 | .20 |
| 4 | 4.4 | 4.026 | .374 | 5.15 | 5.22 | 5.47 | 5.51 | 5.67 | 5.75 | 6.31 | .94 | 1.2 | 8 | .6225 | .28 | 1.8425 | 1.5 | 4.81 | 5.19 | .008 | .22 |

### Description Accompanying Table of Malleable Pipe Unions.

Column No. 1 in the table gives the nominal diameters of pipe.

No. 2 gives the diameter of pipe at one-half the height of full thread nearest solid section of pipe.

No. 3 gives the internal diameter of the pipe.

No. 4 gives the difference between Nos. 2 and 3 and is equal to twice the thickness of metal in pipe measured from inside line to one-half the height of thread, as specified before.

No. 5 gives the outside diameter of end of pipe union, and is taken as No. 2 plus twice No. 4 plus an arbitrary increment.

No. 6 is equal to No. 5 plus an increment varying from 0.04 to 0.07 inch. This increment was allowed for the purpose of being able to slip the nut over the upper swivel end of union.

No. 7 is No. 6 plus an amount varying between 0.15 and 0.25. This lip created is considerably in excess of what exists on present pipe unions, for the reason that we find the surface between the lip and the corresponding part of nut is often damaged, and the bearing surface, when the full strength of the man is used on the wrench, is sufficient. We assume that a man would pull about 30 pounds on a wrench, with a possibility of using less force on pipes of small diameters. For that reason we made a variation in the width of the lip, which lip, theoretically, would be uniform for all sizes of pipe. The nut itself has been strengthened to prevent the lip from deflecting upward.

No. 8 is No. 7 plus an increment varying from 0.02 to 0.04 inch.

No. 9 is No. 8 plus twice the height of the thread.

No. 10 is No. 9 plus an increment varying between 0.04 and 0.08 inch.

No. 11 is No. 10 plus one and one-half times No. 4.

No. 12 is two and one-half times No. 4, and was figured especially for bearing surface, so that the thread would not wear too rapidly when the nut is occasionally removed.

No. 13 has been assumed arbitrarily, but in all cases is greater than the length of full thread on standard pipe.

No. 14 gives the number of threads per inch in length of nut. This thread, we believe, should be United States standard form and not sharp thread.

No. 15 is taken arbitrarily, but is based on the probable requirements of manufacturers for tapping out the nut.

No. 16 is three-fourths of No. 4.

No. 17 gives the full height of nut and is equal to No. 12 plus No. 15 plus No. 16.

No. 18 is the amount of projection outside of nut.

No. 19 is No. 2 plus No. 4 plus an arbitrary increment.

No. 20 is No. 7 less No. 16, with slight modifications.

No. 21 gives the clearance at several points, as indicated in cut.

No. 22 is assumed arbitrarily.

bars being of sufficient length to be supported 11 inches either side of the center of the union, load being applied on center of union nut. Breakage occurred at different points, indicating fairly uniform strength. The average breaking stress of three pieces, ½-inch, was 730 pounds, minimum 710, maximum 750; of 2-inch, the average was 7,930 pounds, minimum 7,800, maximum 8,000.

to have standard gages prepared for the finished parts, i. e., the thread and collar of the nut, the external thread and finished parts of the nose piece, and the external finished portions of the swivel. The threads for pipe connections are already established standards recommended by the American Society of Mechanical Engineers, being the Briggs standard for pipe threads.

## NEW UNIVERSAL MILLING MACHINE.

A universal milling machine of new design throughout, having many novel features in the arrangement of its mechanism, is shown in the accompanying illustrations. It is manufactured by James & Foote, 58-60 South Canal Street, Chicago, Ill. The main features of the new design are a new arrangement of feed box mechanism; a new dividing head and improved tailstock for the same; an arrangement of feed levers in front of the knee so that the operator can throw in or out any or all of the feeds without leaving his position;

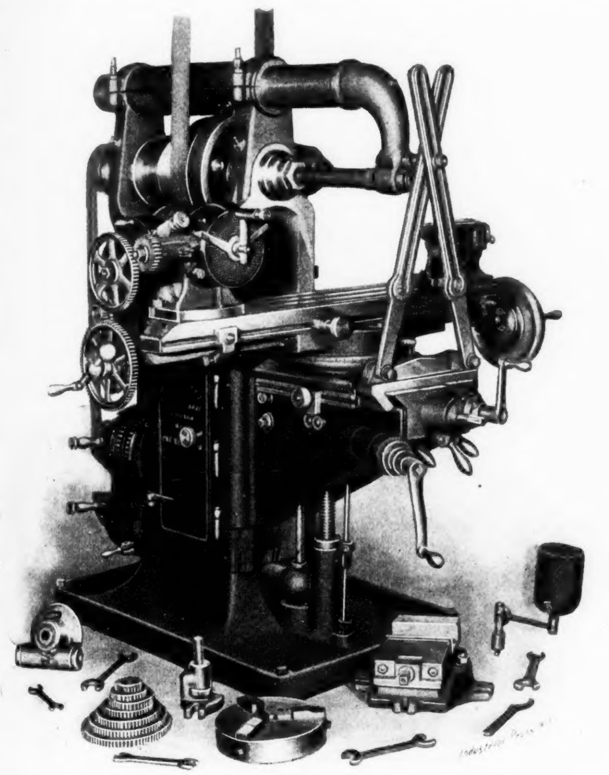


Fig. 1. James & Foote Universal Milling Machine.

and a new design of quick return to the platen. It should be mentioned also that the face of the main column, between the vertical ways, is made concave so that the base of the universal slide may be made in the form of a full circle and still allow the platen to be brought close to the column, the circular portion of the slide passing into the concave face of the column.

The feed box is placed at the rear of the column, near its base. Power is transmitted to the feed gears through a vertical belt driving from a pulley on the rear end of the main spindle. The arrangement of the feed box is shown in Fig. 2. Power is taken from the belt by pulley *P* on shaft *S*. A lever *L* carries a pinion 1, which is splined to shaft *S*. On the lower end of the lever is a pinion 2, which meshes with pinion 1; the lever both pivots and slides on shaft *S*, so as to bring pinion 2 in contact with any one of the four cone gears, all of which are fast together and turn on the intermediate shaft shown. Below the cone gears is a shaft *M*, on which is another lever carrying two gears similar to those of lever *L*, and one gear of which appears at 5. The gears of the lower lever can be brought in contact with any one of the gears of the intermediate cone. With the various parts in the position shown, the drive is as follows: From shaft *S*, through gears 1, 2, 3, 4 and 5, to shaft *M*; the latter drives shaft *N* by means of pinions 6 and 7; in case pinion 7 were moved to the right by the shifting arrangement shown, motion to shaft *N*, would be transmitted from gear 8 to gear 6. This mechanism is capable of giving 32 different feeds, and they are arranged to vary from .002 to .250 for one revolution of the spindle.

The feed motions are carried to the milling machine knee by a horizontal shaft, passing from the feed box, through the base of the machine, to a pair of inclosed mitre gears, and thence to the mechanism in the knee by a vertical shaft appearing in the engraving back of the screw which supports the table knee. This does away with the universal joint so commonly used and gives a uniform feed motion for all positions of the knee.

The mechanism in the knee for driving the various feed motions is very compact and consists of geared connections with suitable clutches, controlled by handles in front of the knee. The feed construction allows the operator to work any or all the feeds by placing a crank wrench on the central shaft projecting in front of the knee and disengaging the platen feed. By engaging the feed clutch in front of the knee the saddle may be in or out at a ratio of 2 to 1 on the screw. By engaging the vertical feed clutch the operator can raise or lower the knee at a rate of speed not attainable on other machines of this type. For the quick return to the platen the operator has the option of using a 4 to 1 or a 1 to 1 ratio. All feed screws are provided with large dials graduated to thousandths, and the design of the platen is such that there can be a dial at each end of its feed screw.

The new design of dividing head provides for a large wormwheel 7 inches in diameter with forty teeth, 6 pitch. The head can be rotated on its own axis 190 degrees, thereby enabling the operator to use the head on either end of platen. The indexing dial is mounted on the axis of the head, allowing the use of the large dial without interfering with the work to be operated upon. Rotation is given to the worm from the indexing shaft through gearing on the inside of the head, free from dirt and chips. The worm can be disengaged for plain indexing. The wormwheel is of the most approved form, being made of two plates doweled and screwed together. During hobbing the parts are repeatedly shifted relatively to each other so that local errors are gradually eliminated. In this manner a practically perfect wormwheel is made. The head has a circular base which can be mounted on the graduated base of the vise and its spindle set in alignment with the

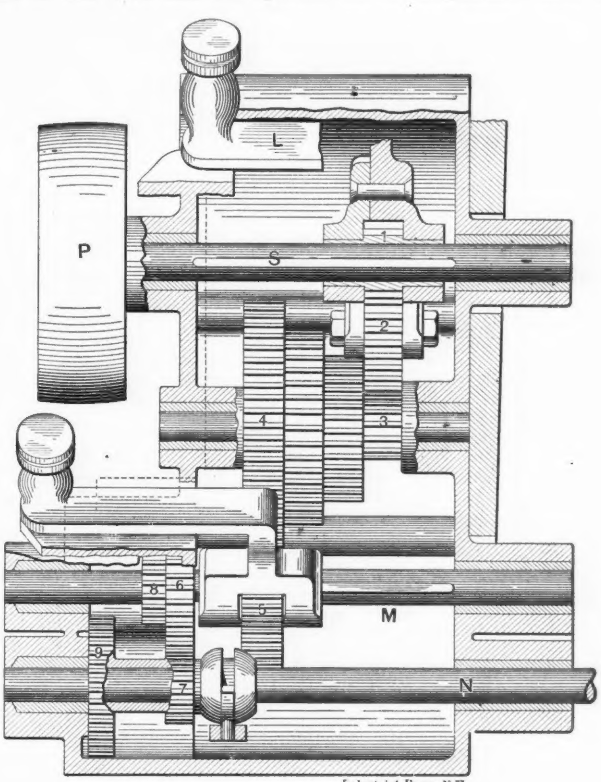



Fig. 2. Arrangement of Feed Box.

milling machine spindle whatever the angle of the table. The head swings 12½ inches over the platen and 16½ inches when placed on the base. The tailstock can be elevated by a vertical screw graduated to thousandths and can be swung to an angle of 30 degrees out of the horizontal.

The machine has a hammered steel spindle running in self-centering bronze boxes and a four-step cone, the largest being 12 inches in diameter for a 3-inch belt. It was designed with a view to adapting the universal milling machine to an unusually wide range of work.

## FRESH FROM THE PRESS.

WATER-TUBE BOILERS. By Leslie S. Robertson. Published by D. Van Nostrand Co., New York. 214 8vo pages. Illustrated. Price, $3.

The matter in this book is based upon a course of lectures upon water-tube boilers, delivered at University College, London. The book is devoted to a description of a great many types of water-tube boilers and of boiler appliances. Some tables of proportions are given.

PARTS XVII. AND XVIII. OF EASY LESSONS IN MECHANICAL DRAWING AND MACHINE DESIGN, by J. G. A. Meyer, have been issued by the Industrial Publication Co., New York.

Since Mr. Meyer's death the manuscript prepared by him has been arranged for publication by his associate, Mr. Charles G. Peker, and these sections of Mr. Meyer's elaborate work on drawing and machine design are prepared with the same care and have the same high standard of the former numbers. The price of each section is 50 cents.

CAST IRON, A RECORD OF ORIGINAL RESEARCH. By William J. Keep. Published by John Wiley & Sons, New York. 225 8vo. pages. Illustrated. Price, $2.50.

This volume was prepared in response to requests that the results of the author's researches in the study of cast iron might be gathered together and presented in convenient form for reference. Mr. Keep has done much to advance the knowledge of foundrymen in the subjects of mixtures of irons, the strength of iron, methods of testing, etc. The book contains records of extensive tests to determine the physical properties of cast iron, and particular attention is paid to the author's investigations regarding shrinkage of cast iron. Decided opinions are advanced regarding the best method for founders to pursue, and it is held that he may be able to use the shrinkage test in all cases in order to determine the quality of iron. The methods of applying these tests are briefly and conveniently summarized.

POWER AND TRANSMISSION. By E. W. Kerr, Assistant Professor of Mechanical Engineering, Agricultural and Mechanical College of Texas. Published by John Wiley & Sons, New York. 356 pages. Illustrated. Price, $2.00.

As a text-book for manual training schools and schools of mechanic arts this volume will undoubtedly find much favor, as the treatment of the subject is very elementary. The book will prove valueless, however, to the engineer or to the student who is attempting to obtain a substantial education in engineering subjects. The reasons for this is that the scope of the work is so extensive that the author was able to give only a superficial treatment. While this would enable a young student to obtain a good general knowledge of power and transmission, the information would be of but little value in designing. The list of subjects is somewhat appalling for a single volume, there being eight chapters on applied mechanics and mechanism, several upon the steam engine, including compound engines and condensers; indicators, the steam boiler, etc., while pumping machinery, gas engines, water power, compressed air and hot air engines all come up for consideration.

VELOCITY DIAGRAMS, THEIR CONSTRUCTION AND USES. By Charles William McCord, Professor of Mechanical Drawing, Stevens Institute of Technology. Published by John Wiley & Sons, New York. 116 pages. Illustrated. Price, $1.50.

This treatise is an abstract of a series of lectures given to the students of Stevens Institute. It is in effect a theoretical work upon kinematics or the study of mechanical movements. It explains graphic processes for determining at any given instance the direction and velocity of motion of the point, whether that motion be constant or variable. Apparently the book is valuable more as a work to give training in the theoretical principles of mechanical movements than as a work for the engineer. This is particularly so from the fact that the pressures transmitted rather than the velocities in mechanical movements are more important for the designer, and the pressures in most instances can be determined by simple applications of the parallelogram of forces.

THE INDICATOR HANDBOOK, VOL. II. By Charles N. Pickworth. Published in London, and for sale by D. Van Nostrand Co., 25 Murray St., New York. 132 12mo pages. Illustrated. Price, $1.50.

The first volume of this treatise dwelt upon the construction and application of the indicator. Volume II. takes up the indicator diagram. There is an introductory chapter, after which follow: The diagram in detail; diagram analysis; diagrams from compound engines; diagrams from gas and oil engines; diagrams from air compressors, pumps, etc.; diagram calculations. While this treatment of the subject is prepared from the standpoint of English practice, it is a valuable work for American readers, and is the most complete treatise on the indicator with which we are acquainted.

METALLURGY OF CAST IRON. By Thomas D. West. Third edition, revised and enlarged. Published by the Cleveland Printing and Publishing Co., Cleveland, Ohio. 627 12mo pages. Illustrated. Price, $3.00.

The books by Thomas D. West upon practical foundry work have become widely known and are considered comprehensive treatments of general principles of foundry practice. This book takes up the metallurgical side of the subject, without, however, going so deeply into the subject of chemistry as not to be understood by the non-technical reader. Foundry mixtures, physical tests of iron, the manufacture and use of coke, the properties of ores, etc., suggest the ground covered. The author calls particular attention to the section containing a compilation of the American Foundrymen's Association tests, which are valuable by reason that each grade was poured from one ladle of iron inside of about twenty seconds, thus causing all the bars of each set to be poured at the same temperature.

## ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

THE FRANK MOSSBERG CO., Attleboro, Mass. Catalogue of bicycle and automobile bells and of small pipe wrenches which are illustrated in another part of this issue.

THE AMERICAN BLOWER CO., Detroit, Mich. Illustrated catalogue No. 135 of hot blast apparatus, for heating shops, factories and other buildings. The catalogue illustrates the heaters, blowers, and the engines used for driving the blowers.

O. S. WALKER & CO., Worcester, Mass. Catalogue D of grinding machinery. In this catalogue are shown their new line of surface grinder, of which one is illustrated in the department "New Tools of the Month." There are also shown the Walker tool grinders, rotary chucks, etc.

THE LINK-BELT ENGINEERING CO., Nicetown, Philada. Catalogue of the Renold silent chain gear. This is the chain that has recently attracted so much attention and that has the peculiarity of automatically taking up the wear occurring on the chain and the sprocket. It is used for all kinds of power transmission.

JAS. CLARKE, JR., & CO., Louisville, Ky. Illustrated catalogue of electrically driven tools. These are small tools with motors attached, and include a sensitive drill, a shop saw of substantial design, a semi-radial drill, a tool grinder, and a neat center grinder, which can also be used for cutters and reamers.

THE WATSON-STILLMAN CO., 204-210 East 43d St., New York. Catalogue No. 63 of hydraulic valves and fittings. This shows valves as made by this company for use in connection with different kinds of hydraulic machinery, such as presses, accumulators, draw benches, etc. A great many fittings are shown, packing leathers, and other hydraulic appliances.

WYMAN & GORDON, Worcester, Mass., makers of drop forgings, are issuing some attractive circulars which can be scarcely classed as advertising matter. The two at hand contain, one a short story of James Watt and his work, with an illustration made from a bas-relief of the inventor, which is supposed to be very old; the other a short history of Matthew Bolton.

THE BILLINGS & SPENCER CO., Hartford, Conn. Catalogue of drop hammers, trimming presses, etc. The new features in this catalogue over previous editions are a new die shoe with which their presses are now fitted, a metal board guard, a Lombards lifting jack for drop hammers and a new heating furnace. The shipping weight and cubic measurements of hammers are now given, for convenience in shipping.

FAY & SCOTT, Dexter, Me. Illustrated catalogue of machine tools. These include engine lathes, from 13-inch to 32-inch swing; turret lathes, both with the turret on the carriage and with the turret in place of the tailstock; a 12-inch shaper, and an automatic spindle drilling lathe. There is also shown a universal turret lathe, having a special turret on the carriage. They have also issued a new catalogue of their patternmakers' machinery, in which are shown patternmakers' lathes in various sizes, for both the largest and the smallest work.

## MANUFACTURERS' NOTES.

MR. REUBEN C. HALLETT, who has a large circle of friends throughout the country, has accepted a position with the Chicago Pneumatic Tool Company's Eastern sales department.

THE CLING-SURFACE MFG. CO., Buffalo, N. Y., have published an attractive circular telling about some of the curious uses to which Cling-Surface was put at the Pan-American Exposition. It was used on belts for driving machinery in every part of the grounds.

THE NEW PROCESS RAW HIDE CO., Syracuse, N. Y., report business very good. They had an order from the British Westinghouse Electric & Mfg. Co. for 60 of their New Process noiseless pinions and add that orders from other sources are coming fast.

FLATHER & COMPANY, Incorporated, Nashua, N. H., have been organized since December 4th, to carry on the business of the firm of Flather & Company, now dissolved. The newly-organized company will collect all accounts and assume all liabilities of Flather & Co.

THE BURT MFG. CO., Akron, Ohio, have received a sixth order from the Calumet & Hecla Mining Co. for Cross oil filters, making twelve of these filters now in use in their different mines. The Burt Company receive also a large number of "repeat" orders from the larger concerns.

GEO. BURNHAM & CO. (Frank Reed, proprietor), of Worcester, Mass., have purchased the land for a shop in Hammond St., Worcester, and will begin to erect a building for their business in the spring, which will be about 40 x 125 feet. This increase in their facilities has been made necessary by a steady growth in their business and in the sales of their drills and other specialties.

THE HODGE BOILER WORKS, East Boston, Mass., a firm that was first established in 1865 by Ebenezer and James Hodge and carried on by John E. Lynch, is now incorporated under the laws of the State of Massachusetts, and has moved to a new shop, Sumner Street, East Boston, where, with increased facilities for promptly turning out marine and stationary boilers, tanks, etc., they hope for a continuance of the patronage given them in the past.

THE BUFFALO FORGE CO., Buffalo, N. Y., recently received from Wm. Garstang, superintendent of motive power at Indianapolis, a copy of a letter which he sent to the Embree McClean Carriage Co., St. Louis, an extract of which is as follows: "Our Wabash shop is equipped with the Buffalo down-draft forges. I consider them a success, especially in so far as they keep the shop free from smoke and gas. I don't believe there is a forge better adapted for the work than the one in question."

H. A. PEDRICK, formerly connected with and superintendent for the Pedrick & Ayer Co., who resigned three years ago to engage in the construction of a mining plant and standard gage railroad in South America, has returned and has started in business in Philadelphia with Mr. Charles A. Smith, under the name of H. A. Pedrick & Co. The new firm is equipped for general machine business, but has particularly in view the manufacture of certain specialties, which will be mentioned later.

THE CLING-SURFACE MFG. CO., Buffalo, N. Y., received recently a letter from the Carnegie Steel Co., Homestead Works, stating that some 12-inch belts they were using on arc machines were stretched as far as the tightening slide would allow, at which point the belts would have to be shortened. After some experimenting they adopted the Cling-Surface belt dressing, and are now running the same belts slacked up so that they sag to within about 8 inches of the tight side when loaded.

THE STANDARD PNEUMATIC TOOL CO., Aurora, Ill., announce that they are about to erect in Berlin, Germany, works for the manufacture of "Little Giant" pneumatic tools and appliances for supplying the trade in continental Europe. They add that there is a great demand for these tools in Europe, particularly in France, Germany and Holland. Mr. W. H. Tew, formerly with the mechanical engineering department of the Chicago & Northwestern Railroad, has been appointed managing director. The export business of the company during last December was 100 per cent greater than that of December, 1900.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., through the generosity of its founders and of several prominent manufacturers, are able to offer each year a few free scholarships in engineering courses to worthy and energetic young men. The scholarships for 1902 are now available, and applications from among the readers of MACHINERY will be considered. Never before was the demand so great for men with skilled hands and trained minds, and to these the doors to progress and success stand open. The opportunity here presented of obtaining gratis a technical education, with the help of instructors specially qualified in all branches of engineering, should appeal to the ambitious young man.

THE CHICAGO PNEUMATIC TOOL CO. of New Jersey is a unification of the five following companies: The Chicago Pneumatic Tool Co. of Illinois; the Boyer Machine Co., Detroit, Mich.; the Chisholm & Moore Crane Co., Cleveland, Ohio; the Franklin Air Compressor Co., Franklin, Pa., and the new Taite-Howard Pneumatic Tool Co., Ltd., London, England. The company starts with a working capital largely in excess of a million dollars. The company's executive board announce the following appointments: W. O. Duntley, Vice-President and General Manager; C. E. Walker, Assistant General Manager; Thomas Aldcorn, General Sales Agent; W. P. Pressinger, General Manager Air Compressor Department; Chas. Booth, Manager of Chicago Office, and S. G. Allen, Manager of New York Office. The company are devoting especial attention to air compressors and report the outlook very encouraging. Among recent orders received was one from the Lehigh Valley R. R. Co. for seven 500-foot air compressors.